

PROJECT OPERATIONS PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA

OCTOBER, 1988

SEC JOB NO. G-8026

SIRRINE ENVIRONMENTAL CONSULTANTS
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1.0 INTRODUCTION

This draft Project Operations Plan (POP) has been prepared by Sirrine Environmental Consultants (SEC) for the Medley Farm Site Remedial Investigation/Feasibility Study (RI/FS) at the direction of the Medley Farm Site Steering Committee. The RI/FS is being prepared under an Administrative Order of Consent signed in January 1988 from EPA Region IV.

The Work Plan for the Medley Farm Site was approved by EPA Region IV in September, 1988 (RI/FS Work Plan, Medley Farm Site; SEC, August, 1988). The purpose of the POP is to provide detailed procedures for conducting the Remedial Investigation activities specified in the Work Plan. The POP combines two previously separate documents, the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP), as directed by the draft EPA document Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (March, 1988). Requirements of the FSP include:

- o Site Background
- o Project Objectives
- o Sample Location and Frequency
- o Sample Designation
- o Sampling Equipment and Procedures
- o Sampling Handling and Analysis

Requirements of the QAPP include:

- o Project Description
- o Project Organization and Responsibilities
- o QA Objectives
- o Field Investigation Procedures
- o Sample Custody
- o Calibration Procedures
- o Analytical Procedures
- o Data Reduction, Validation, and Reporting
- o Internal Quality Control
- o Performance and Systems Audits

- o Preventative Maintenance
- o Data Assessment
- o Corrective Actions

Elements of the FSP are discussed in Sections 2 and 5 of the POP while elements of the QAPP are given in Sections 2 - 13. In addition, the Health and Safety Plan to be used during the RI/FS effort has been included as Appendix A of this document.

The POP has been prepared in accordance with the following documents:

- o National Oil and Hazardous Substances Contingency Plan
- o Guidance on Remedial Investigations Under CERCLA (EPA/540/G-85/002, June, 1985)
- o Draft Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (OSWER Dir. 9335.3-01, March, 1988)
- o EPA - Region IV Standard Operating Procedures and Quality Assurance Manual, April, 1986.

The POP is subject to revision throughout the investigation to accommodate each phase of the RI process and unexpected field conditions. Any changes to POP procedures or sampling locations will be documented in writing to the EPA-Region IV RPM.

2.0 PROJECT DESCRIPTION

2.1 ENVIRONMENTAL SETTING

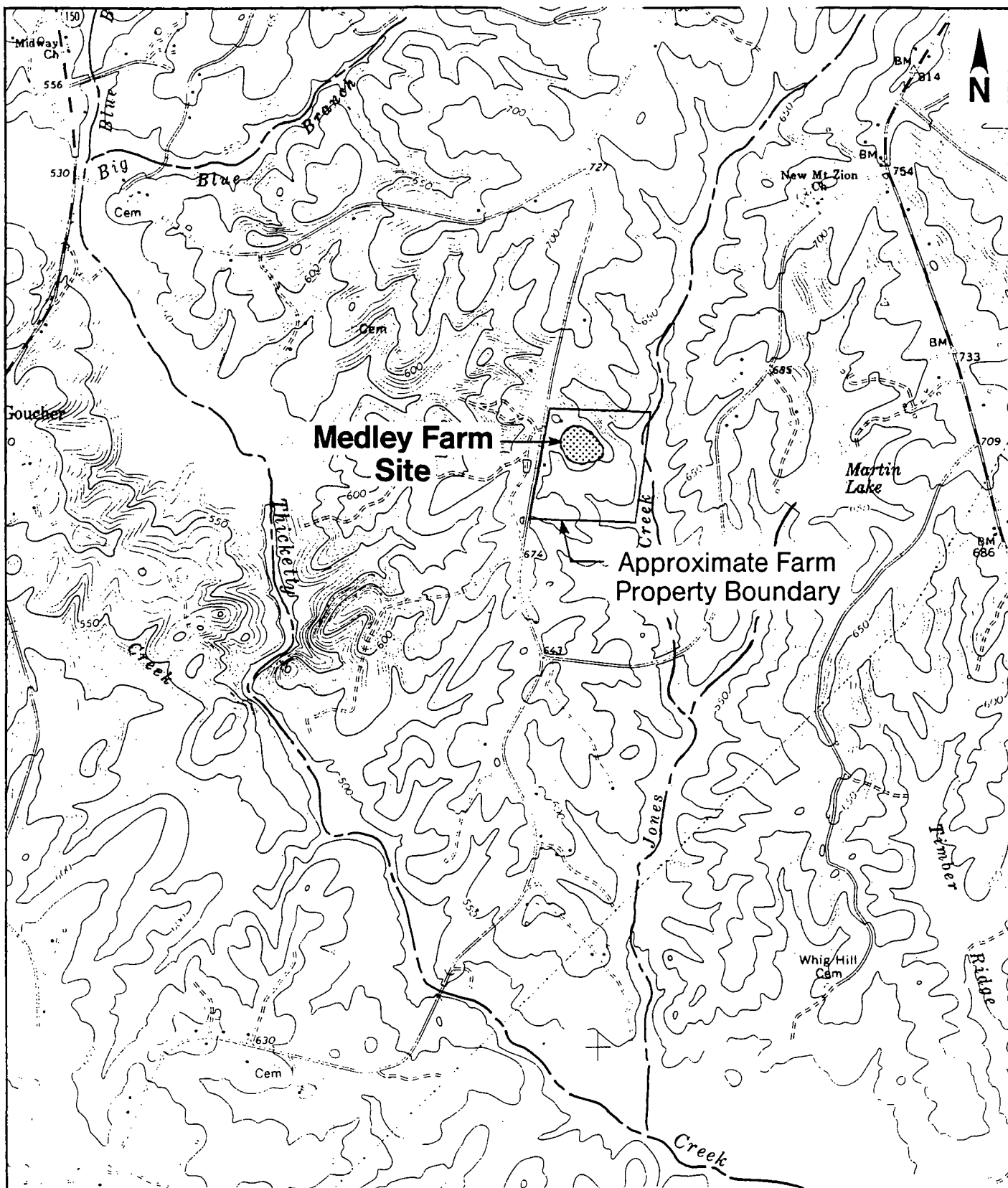
The Ralph Medley Farm occupies 61.9 acres of rural land approximately six miles south of Gaffney, South Carolina in Cherokee County on County Road 72 (Burnt Gin Road). The approximate property boundaries are shown in Figure 2.1. The Medley Farm site consists of an approximately 7-acre section of the Ralph Medley Farm parcel that is situated on top of a small hill. The approximate center of the site is located at latitude 34°58'54" north and longitude 81°40'2" west. The surrounding land is hilly and consists mainly of woods and pasture land. The land use in the vicinity of the site is primarily agricultural (farms and cattle) and light residential.

The Medley Farm site ranges in elevation from 680 to 700 feet above mean sea level. Topography of the site area is relatively flat but the adjacent land slopes off steeply to the east and south. Surface water drainage from the site flows into Jones Creek, located along the eastern property boundary. Jones Creek flows into Thicketty Creek which then drains into the Broad River.

2.1.1 Geology

The Medley Farm site is located in the Piedmont physiographic province. This province is characterized by fractured and faulted igneous and metamorphic rocks of Precambrian and Paleozoic age. These crystalline rocks are grouped into six northeast-trending lithologic belts which are interpreted to be zones of different grades of regional metamorphism. The belts are, from southeast to northwest: the Carolina slate belt, the Charlotte belt, the Kings Mountain belt, the Inner Piedmont belt, the Brevard belt, and the Blue Ridge belt.

The site is in the Kings Mountain belt, which consists of metasedimentary and metavolcanic rocks of low to moderate metamorphic grade. Rock types include schists, quartzite, marble, gneiss, and granite, with minor units of soapstone, pyroxenite, and mafic rocks. Rocks in the Kings Mountain belt



USGS Pacolet Mills Quadrangle (1969)

Scale 1:24,000

Figure 2.1

Approximate Boundaries of Medley Farm Site and Farm Property

Medley Farm Site Gaffney, South Carolina

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reflect an episode of Carboniferous- to Permian-age metamorphism of sedimentary rocks. Metamorphism was accompanied by folding, fracturing, intrusion of cross-cutting granites, and the upgrading of earlier formed minerals along granite contacts (Overstreet and Bell, 1965).

No rock outcrops have been observed at the site or in the immediate vicinity. However, according to a map published in 1965 by Overstreet and Bell, the specific rock types underlying the site are hornblende gneiss and quartz monzonite. The scale of that map is small; consequently this interpretation may be modified based on site field investigations. Regional strike of the rocks is to the northeast and regional dip is southeast. This has been a consideration in the initial siting of monitoring wells presented in Section 3.6.3.

Soils in Cherokee County are primarily residual soils (saprolite) derived from in-situ weathering of the underlying bedrock. This soil layer, or overburden varies in thickness. It is thinner on hilltops where erosion has been most active, and thicker in valleys, where less erosion and more deposition has occurred. The site is on a ridgetop, but erosion has incised valleys, or gullies, very near the site.

2.1.2 Hydrogeology

In general, a dual aquifer system exists in the Piedmont Province. The surficial aquifer consists of saprolite and wells completed in these materials produce low yields. The bedrock aquifer is either igneous or metamorphic rock with secondary porosity; well yields depend on the nature of the fractures that the well encounters. The surficial aquifer has higher porosity but due to its low hydraulic conductivity acts mainly as a storage media and recharge source for the bedrock aquifer.

Two wells drilled at the Medley Site in 1984 indicate that the water table may occur relatively deep at this site location. This may serve to isolate significant portions of any residual contamination that may remain on-site. One well was drilled to 54 feet below land surface (bls) without encountering the water table. A second well bottomed out at 85 feet bls and

had 20 feet of standing water prior to development. The well was then pumped dry and required 45 minutes of recovery time in order to collect approximately one-half liter of water. Both wells were in saprolitic deposits and point to the surficial aquifer here being primarily a storage media for recharge to the bedrock aquifer. Therefore, the major volume of ground water flow away from the site is believed to be within the bedrock aquifer.

Surface topography and the direction of dip of the rocks is to the southeast at the site. Surficial ground water flow in the aquifers at the site would most likely follow the surface topography and, thus, move toward the major streams. Since Jones Creek and the Big Blue Branch are described as perennial streams, some ground water discharge would be expected to occur. The source of the baseflow - the surficial aquifer, bedrock aquifer, or both aquifers - would have to be determined through field studies. Thicketty Creek, the largest stream in the area, has cut and flows within an alluvial valley. It may be a ground water flow divide for the surficial aquifer and, possibly, the bedrock aquifer. Monitoring wells and other field activities have been constructed to evaluate these situations.

In summary, the surficial aquifer at the site exhibited low flow capacity and is locally believed to be mainly a source of recharge for the bedrock aquifer. Ground water flow in the aquifers at the site would most likely be predominantly within the bedrock aquifer and would follow the topography toward the major streams. Jones Creek, the Big Blue Branch, and Thicketty Creek are all perennial streams, and therefore, receive baseflow during long, dry periods. These streams may be flow divides for the surficial aquifer.

Information will be developed in the RI to evaluate whether Jones Creek, the Big Blue Branch, or Thicketty Creek act as permanent ground water flow divides for both the surficial and bedrock aquifers in this area.

2.1.3 Surface Waters

The Pacolet Mills 7.5 minute quadrangle, as shown in Figure 2.1, labels Jones Creek, the Big Blue Branch, and Thicketty Creek - the three largest streams surrounding the site - as perennial streams. Jones Creek and the Big Blue Branch are fed by lakes and intermittent streams. Thicketty Creek is the largest of the three and is fed by other perennial streams and smaller intermittent streams. Flow in perennial streams during long, dry periods would be due only to ground water discharge (baseflow) and outflow from lake storage. The Medley site appears to have the greatest potential for potentially impacting surface water in Jones Creek. For this reason sampling efforts have been directed towards evaluation of this surface feature.

Jones Creek and the Big Blue Branch both flow into Thicketty Creek. Thicketty Creek empties into the Broad River. Thicketty Creek from the Cowpens discharge tributary to the Broad River is classified as a "B" stream. Class B streams are freshwaters suitable for secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the State. Jones Creek and the Big Blue Branch are not among the classified waters in the South Carolina water classification standards.

2.1.4 Climate

The climate of the area is generally mild, with average summer temperatures of 76.4°F and average winter temperatures of 41.9°F. The average annual temperature is 60.0°F. Total precipitation for the area is 50.1 inches and total evapotranspiration is 37.8 inches, giving a net precipitation of 12.3 inches (Smith, 1987). The one-year, 24-hour maximum rainfall is 3 inches. Climatological information is based on data collected at Spartanburg, South Carolina, located approximately 18 miles west of the Medley site.

2.2 SITE HISTORY

The Medley (also known as Burnt Gin) Farm is owned by Ralph C. Medley, who acquired the property from William Medley in 1948. Prior to the mid-1970s, the site was maintained as woods and pasture land. Available information indicates that disposal of drummed and other waste materials began at the site in 1973. Waste disposal at the Medley site reportedly stopped in June 1976. At the time of the SCDHEC inspection, drums were stored on site in a random fashion. Some were in open pits or one of six small lagoon areas. No formal records of disposed waste materials were kept at the Medley Farm Site.

2.3 SITE INVESTIGATIONS AND REMEDIATION

On May 3, 1983, members of the Compliance and Enforcement Section of the SCDHEC Bureau of Solid and hazardous Waste Management visited the Medley Farm site and observed approximately 2,000 55-gallon drums in various states. The drums were piled randomly over the area and a chemical odor was noted. A number of shallow excavations were observed which contained discolored standing water. It was noted that some drums were standing or lying in the water in these pits and it was noted that some burial of drums may have occurred. A number of the drums were observed to be in a deteriorated condition. Areas of distressed vegetation were noted where possible drum discharges may have occurred. In addition to the 55-gallon drums, there were several hundred plastic containers of various sizes. Most of these drums were in a condition that markings were no longer visible. Contents of most drums could not be identified.

Based on this inspection, SCDHEC returned on May 19, 1983 to collect samples of drum contents and soils for analysis. Results of analyses reported a number of volatile organics, including methylene chloride, trichloroethylene and trans-1,2-dichloroethylene, and base neutral extractable compounds. No acid extractable compounds were detected among the analyses performed. Certificates of analysis for the May 1983 SCDHEC investigation are given in Appendix A of the previously submitted Work Plan.

SCDHEC informed EPA of the sampling results and EPA visited the site the week of May 30, 1983. Samples were collected for analysis. Among the contaminants found were: methylene chloride, vinyl chloride, tetrachloroethylene, phenol, toluene, trichloroethylene and 1,2-dichloroethane. One on-site composite soil sample contained polychlorinated biphenyls (PCBs) at low levels. Available certificates of analysis for the May 1983 EPA investigation are given in Appendix B of the previously submitted Work Plan.

An immediate emergency removal action was initiated on June 20, 1983 by O.H. Materials Company pursuant to Section 104 and other provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A total of 5,383 drums and 15-gallon containers were removed from the site. These included full, partially full and empty containers. Compatibility testing of drum contents was done prior to bulking of liquid wastes. Empty drums were crushed and taken to a sanitary landfill. The bulked liquids (24,200 gallons) were taken off-site by tanker and incinerated. The solid waste and contaminated soils, totalling 2132 cubic yards, were taken to an approved hazardous waste landfill. Three drums containing PCBs were overpacked and sent to an approved disposal facility. An estimated 70,000 gallons of water were drained from the six small lagoons and treated in a pressurized sand/gravel/activated carbon filtration system for the removal of organics. The treated effluent was analyzed to ensure it met state discharge standards prior to release into Jones Creek. The lagoons were then backfilled with clean earth and graded to the natural topography. Remedial actions were completed on July 21, 1983.

Analytical testing of the drum contents, as well as the water and sediment in the lagoons during the removal action, indicated the presence of organic compounds. These included: toluene, benzene, methylene chloride, tetrachloroethylene and vinyl chloride. Samples from adjacent homeowners' wells were collected by SCDHEC on June 23, 1983 and were found to contain methylene chloride although the well with the highest concentration appears to be upgradient.

NUS conducted a geological and geophysical study of the Medley Farm site at the direction of EPA during the week of August 1, 1983. The study was designed to determine the potential for ground water contamination at the site. To accomplish this, a literature search on the geology and hydrology of the area and a field study of the site were performed. The field study included electrical resistivity soundings, a magnetometer survey and an electromagnetometer (EM) survey. Results of the EM survey are shown in Figure 2.2. The NUS report concluded that the most likely source of the anomalies shown in Figure 2.2 was suspected surface and subsurface soil contamination from previous disposal practices. The magnitude of the anomalies indicated that buried drums are not likely except in one small area as shown in Figure 2.2. The report could not estimate the depth of suspected soil contamination.

Possible fracture zones were estimated from linear surface features called lineaments in the geological assessment. The NUS report concluded that such traces may be conduits for ground water contamination but could not estimate the extent of contamination in these hydrologic systems. Results of the EM survey indicated that suspected subsurface contaminants may have migrated as much as several hundred feet to the southeast, but this is based only on this screening procedure and has not been verified with any sampling. The NUS report stated that the suspected contaminants were most likely confined to the soil layer above the impermeable bedrock.

SCDHEC revisited the site in April of 1984 to perform a preliminary geohydraulic investigation and install a monitoring well. An attempt to construct a well (MD2 in Figure 2.2) was ended when the borehole reached 54 feet without encountering saturated conditions due to auger refusal. A second borehole was advanced at a lower elevation (MD2A in Figure 2.2) that encountered saturated conditions at 65 feet and a monitoring well was installed. Soil from both boreholes and ground water from the well were analyzed for volatile organics, primary metals, acid and base-neutral extractables. Volatile organic analyses of soil taken at 10 feet in borehole MD2 showed 81.4 ug/kg of methylene chloride and 102 ug/kg of 1,2-dichloroethane as the only quantifiable compounds. Ground water sampling results for the volatile organics are given in Table 2.1. Certificates of

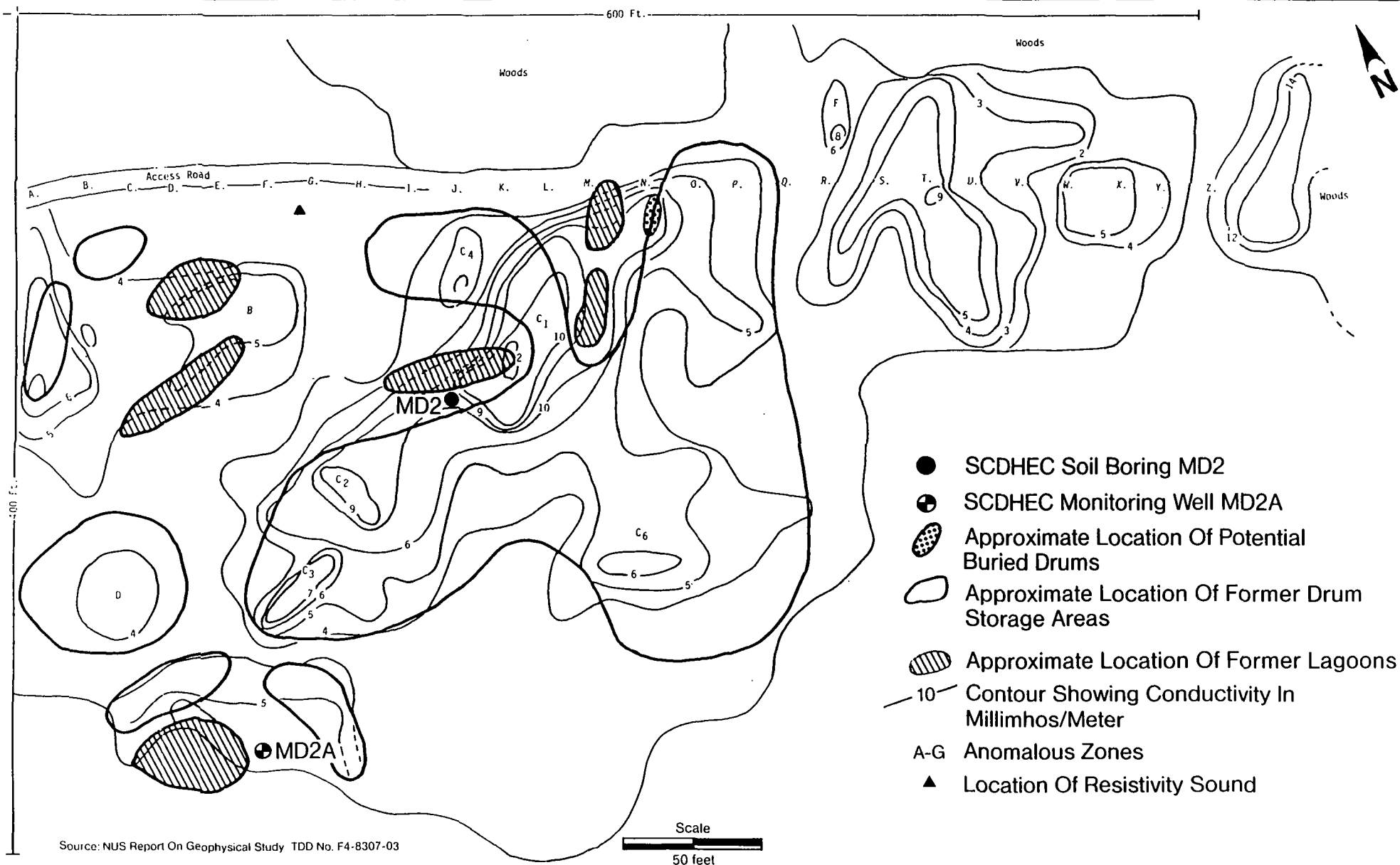


Figure 2.2

Approximate Locations Of Former Drum Storage Areas And Lagoons

Medley Farm Site Gaffney, South Carolina

analysis for the April 1984 SCDHEC investigation are given in Appendix C of the previously submitted Work Plan.

Monitoring well MD2A was resampled by SCDHEC in July of 1984. Four private wells off-site were resampled at this time as well. Results from the monitoring well and one private well (Sprouse) are given in Table 2.1. Based on these analyses, SCDHEC advised the owner of the Sprouse well to no longer use it as a source of drinking water. It should be noted that based on all available information and the surface topography of the area, the Sprouse well would appear to be upgradient of any site activities indicating any contamination identified would not be associated with the Medley Farm Site. The background well locations have been sited to further confirm this observation. This was discussed and agreed upon during the site visit conducted in May 1988 by EPA Region IV and SEC. None of the other private wells sampled (Sarrett, Pittmann, Davis) showed signs of contamination. Locations of the residential wells and certificates of analysis for the July 1984 SCDHEC investigation are given in Appendix D of the previously submitted Work Plan. Analysis of the other three private wells did not indicate the presence of volatile organics. No further analyses of soil or ground water from the site are known to have been performed since July of 1984.

The Medley Farm site was subsequently evaluated by the U.S. EPA in June 1985, using the Hazard Ranking System (HRS). A migration score of 31.58 was assigned based entirely on the ground water route. The Medley Farm Site was proposed for addition to the National Priorities List (NPL) in June 1986.

The extent of potential residual soil contamination is unknown. Any contaminated soil on-site was either removed by past remediation efforts or covered with clean earth during the immediate response action. "Numerous pockets of buried gelatinous material" were found by SCDHEC, during installation of a monitoring well in April 1984. These were observed and noted by EPA during the May 1988 site visit.

No sampling of surface waters or sediments has been done in Jones Creek, the Big Blue Branch, or Thicketty Creek.

TABLE 2.1

GROUND WATER ANALYSES AT THE MEDLEY FARM SITEVolatile Organic Analysis - Well MD2A

		Date of Collection	
		<u>April 13, 1984 (1)</u>	<u>July 18, 1984 (2)</u>
1)	methylene chloride	39.05 ug/l	9.22 ug/l
2)	1,1-dichloroethene	1,887 ug/l	1,645 ug/l
3)	1,1-dichloroethane	160.5 ug/l	43.7 ug/l
4)	trans-1,2-dichloroethene	37.9 ug/l	28.0 ug/l
5)	chloroform	8.0 ug/l	3.56 ug/l
6)	1,2-dichloroethane	22.05 ug/l	7.53 ug/l
7)	1,1,1-trichloroethane	3,362 ug/l	2,188 ug/l
8)	carbon tetrachloride	3,804 ug/l	830 ug/l
9)	trichloroethene	6.6 ug/l	3.143.9/l
10)	1,1,2-trichloroethane	66.9 ug/l	15.3 ug/l
11)	toluene	29.6 ug/l	*
12)	tetrachloroethene	2.5 ug/l	*

Volatile Organic Analysis - Sprouse Well (2)

1)	methylene chloride	678 ug/l
2)	1,2-dichloroethane	2.51 ug/l

* - No value given in SCDHEC analytical results.

References: 1. Workman, 1984(a) (see Work Plan)
2. Workman, 1984(b) (see Work Plan)

2.4 PRESENT SITE CONDITIONS

All visible drums were removed from the site during the emergency action in June-July of 1983. The electromagnetic survey conducted in August of 1983 indicated that the potential for buried drums remaining on-site is unlikely except in one small area. This area will be confirmed during RI test pitting activities. Sludge was removed from the six small lagoons during the emergency action as well. The lagoons are currently covered with clean earth and graded to the surrounding topography. The type and extent of residual soil and ground water contamination, if any, is presently unknown.

The Medley property is no longer in use as a farm. While there are no barriers to prevent access by the public, the site is in a remote location.

2.5 PROJECT OBJECTIVES

The limited investigations of the Medley Farm Site to date have not adequately determined the extent of potential contamination of soils and ground water. The objective of the RI is to obtain the additional data necessary to characterize the site and determine potential risks to human health and the environment. The objective of the FS is to evaluate the results of the RI and provide a basis for selection of a cost effective remedial action that is protective of human health and the environment.

Based on the gathered data, the objectives of the Remedial Investigation (RI) are:

- o developing an accurate topographic site map
- o determining the nature and extent of soil contamination, if any
- o determining the presence of any remaining drums or other containerized waste materials
- o determining the nature and extent of ground water contamination, if any
- o determination of potential mechanisms for off-site transportation of contamination

- o identification of potential receptors and analysis of the predicted impact of contamination on off-site receptors
- o identification of potential areas for remediation

Specific tasks will include sampling of soils, ground water, surface water and any residual waste materials which may be present, plus a geologic and a hydrogeologic assessment of the site and surrounding areas.

The RI field investigations will be conducted in a series of phases to allow for adequate evaluation of data collected in each step and for re-assessment of proposed sampling locations and analytical parameters. The break between Phase IA and Phase IB will be for the evaluation of TCL analyses, serving as a source characterization, and the development of a site-specific list of indicator parameters. The objectives and major elements of each phase are outlined below.

Objectives of the Phase IA Field Investigations are:

- o Investigate the potential presence of residual resources of contamination at the site
- o Characterize residual sources of contamination which may be present
- o Provide an initial assessment of the horizontal extent of residual sources and soil contamination which may be present at the site
- o Develop a set of site specific indicator parameters for use during subsequent sampling and analyses
- o Provide initial characterization of the geology and hydrogeology of the site to guide subsequent assessment efforts
- o Provide an initial assessment of the potential presence of ground water contamination resulting from former activities at the site
- o Characterize the nature of ground water contamination which may be present and ground water flow directions at the site

Phase IA Field Investigations will include:

- o A soil gas survey to confirm the selection of appropriate locations for source characterization efforts
- o Excavation of eight (8) test pits for initial source characterization
- o Installation of four (4) well pairs (8 wells) for ground water sampling and periodic (bi-monthly at minimum) water level measurement
- o Phase IA ground water sampling (two well paris -- MW-2 and MW-4)
- o Hydraulic testing (slug tests and water pressure tests)
- o TCL analyses of four (4) ground water samples and eight (8) soil samples

Objectives of the Phase IB Field Investigation are:

- o Characterize the horizontal extent of any residual sources or soil contamination identified during the Phase IA field investigation to the extent required for the assessment of remedial alternatives
- o Investigate the vertical extent of residual sources and soil contamination which may be present
- o Investigate the extent of ground water contamination which may be present
- o Gather additional data sufficient to support the assessment and feasibility of remedial alternatives

Phase IB Field Investigations will include:

- o Soil borings for additional source characterization
- o Up to seven additional test pits
- o Surface water and sediment sampling
- o Ground water sampling of all monitoring wells
- o Hydraulic testing (pump test)

- o Analyses of ground water, soil, stream sediment and surface water samples for the list of indicator parameters developed during Phase IA.

Phase II (if required):

- o The need for additional work to support the assessment of remedial alternatives and impacts to potential receptors will be evaluated after completion of Phase I and the initial draft Remedial Investigation report.

2.6 PROJECT SCHEDULE

The estimated schedule for completion of the RI/FS is given in Figure 2.3. Time zero of the schedule coincides with EPA approval of the site Work Plan. Implementation of the Work Plan has been divided into discrete tasks to indicate the coordination of parallel and consecutive elements through completion of the RI/FS. Descriptions of the numbered tasks are given in Sections 3 and 4 of the Medley Farm Site Work Plan (SEC, August, 1988). Specific tasks are described in greater detail herein.



Figure 2.3

SCHEDULE FOR Medley Farm Site Remedial Investigation/Feasibility Study

JOB NO. G-8026 DATE 6-8-88 BY JJC/JSC

TASK 1.0 PRELIMINARY ACTIVITIES

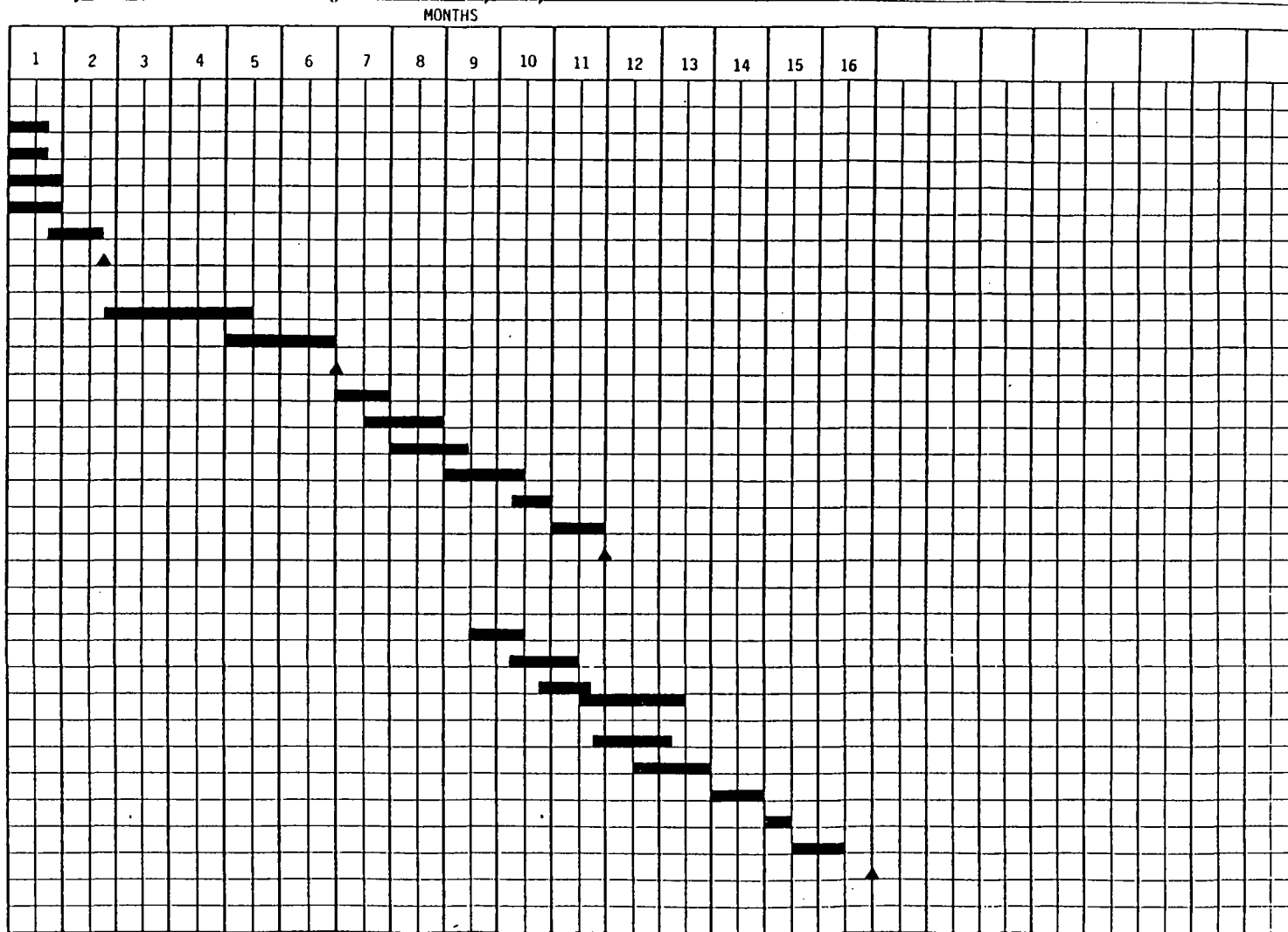
- 1.1 Site Map Preparation
- 1.2 Background Data Review
- 1.3 Project Operations Plan
- 1.4 Project Health & Safety Plan
- 1.5 POP and H&S Plan Review
- 1.6 EPA Approval of POP/H&S Plan

TASK 2.0 REMEDIAL INVESTIGATION

- 2.1 Phase I Field Investigation
- 2.2 Data Analysis and Review
- 2.3 EPA Approval of Indicator Parameters
- 2.4 Phase IB Field Investigation
- 2.5 Data Analysis and Review
- 2.6 RI Draft Report Preparation
- 2.7 Review of Draft Report**
- 2.8 RI Final Report Preparation
- 2.9 Review of RI Final Report
- 2.10 EPA Approval of Final RI Report

TASK 3.0 FEASIBILITY STUDY

- 3.1 Review of RI Results
- 3.2 Develop Remediation Guidelines
- 3.3 Screening of Alternatives
- 3.4 Treatability Studies
- 3.5 Detailed Alternative Analysis
- 3.6 Draft FS Report Preparation
- 3.7 Review of Draft FS
- 3.8 Second Draft FS Report
- 3.9 Review of Second Draft FS
- 3.10 Revised FS Report
- 3.11 ROD Issued
- 3.12 Final FS Report



* Completion of the given schedule is contingent upon favorable weather and site conditions, sub-contractor availability and performance, and timely review by EPA of submitted materials.

**After EPA review of RI Draft Report, the need for additional Phase II Field Investigations will be evaluated.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

3.1 Project Organization

The overall project management organization for the Medley Farm Site RI/FS is shown on Figure 3.1. Overall administrative responsibility for completion of the RI/FS is centered around the SEC project manager. The RI and FS project supervisors will be directly responsible for the coordination and implementation of these respective elements of the project.

Radian Corporation will be the analytical contractor for this project. Analyses will be performed at Radian Corporation's Laboratory located at Research Triangle Park (RTP)/Raleigh-Durham, North Carolina.

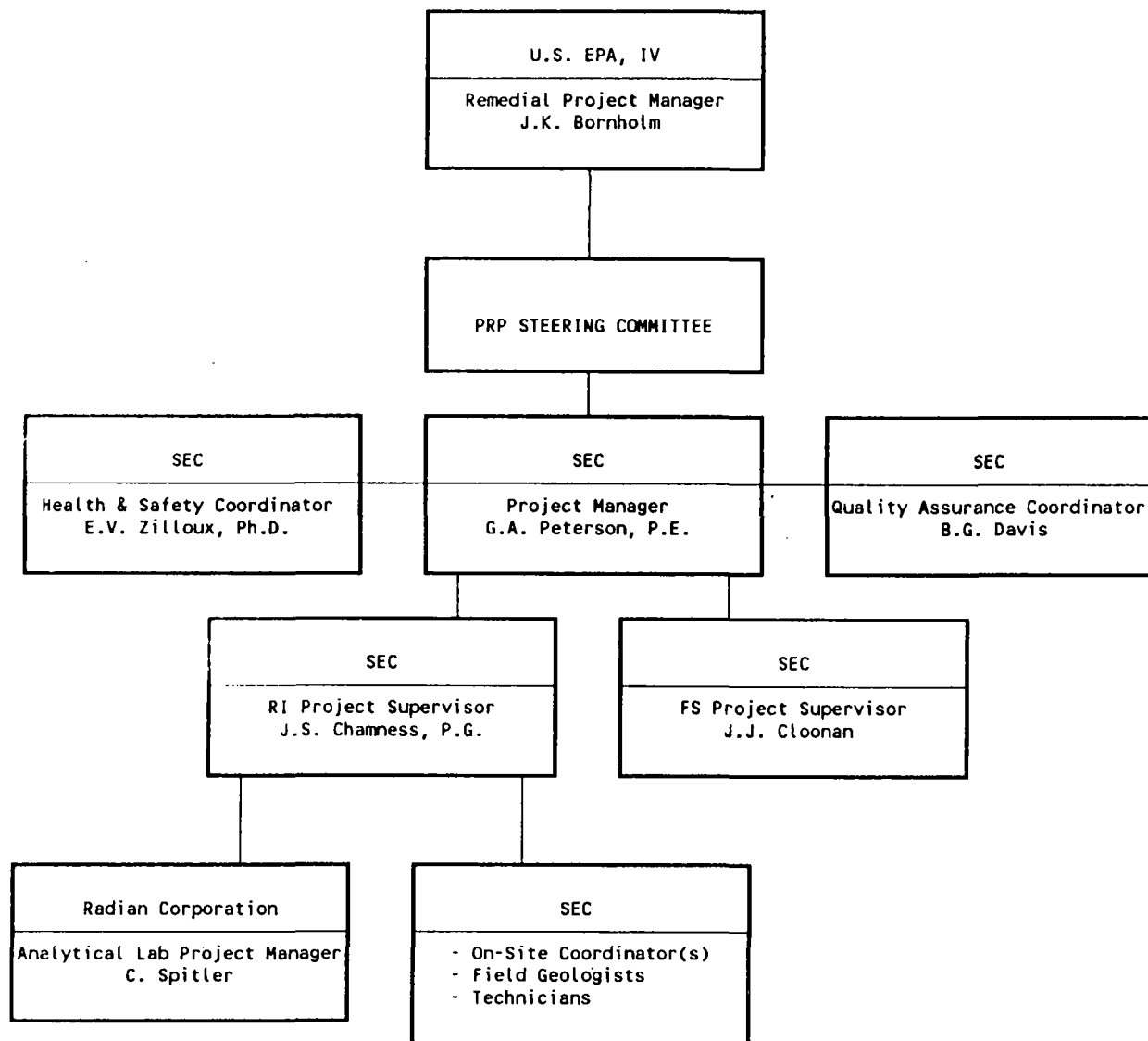
The key individuals responsible for implementation of the RI/FS and their responsibilities are listed below:

Project Manager - Gordon A. Peterson, P.E., Manager of Hydrogeologic Services, SEC, Inc.

The project manager will provide both senior technical oversight and coordination of the overall project. This individual will be the primary contact for the PRPs and will be responsible for all technical elements of the effort as well as project costs.

The project manager:

- o Reviews and approves field operating procedures,
- o Provides senior technical oversight and coordination of the overall project,
- o Assures that approved procedures meet QA/QC objectives of project,
- o Coordinates RI/FS Study activities with Quality Assurance Coordinator,
- o Responsible for implementation of recommendations made by the Quality Assurance Coordinator,
- o Coordinates the activities of the RI and FS project supervisors.



RI Project Supervisor - James S. Chamness, P.G., SEC, Inc. will be directly responsible for the coordination and implementation of all RI activities. This individual reports to the SEC Project Manager but will also interact directly with the PRP steering committee and the EPA Region IV RPM.

The RI project manager's responsibilities include:

- o RI staffing, scheduling and cost control
- o Subcontractor management
- o Day to day technical coordination between the project management team and field personnel for RI field activities
- o Technical oversight of RI
- o Coordination between Health and Safety Coordinator and field personnel

FS Project Supervisor - James J. Cloonan, SEC, Inc. will be directly responsible for the coordination and implementation of all FS activities. This individual reports to the SEC Project Manager but will also interact directly with the PRP steering committee and the EPA Region IV RPM.

The FS project manager's responsibilities include:

- o FS staffing, scheduling and cost control
- o Subcontractor management (treatability testing, if necessary)
- o Coordination with State of South Carolina regulatory personnel
- o Development and screening of potential remedial action alternatives
- o Technical review of all documents and interim reports

Health and Safety Coordinator - Edward E. Zillioux, SEC, Inc. This individual serves as the project Health and Safety Coordinator and will play a primary role in the development of the Health and Safety Plan along with coordinating required instruction and safety documentation. Overall responsibility for the risk assessment and chemical hazard characterization of the public health evaluation will also be assigned to this individual.

Quality Assurance Coordinator - Robert G. Davis, Corporate QC Officer, SEC, Inc. This individual, who reports directly to the president of SEC, will be responsible for all procedures and tasks pertaining to quality assurance for this study.

Specific responsibilities of the Quality Assurance Coordinator include:

- o Monitoring project activities to verify compliance with quality assurance plans
- o Implementing routine quality assurance audits for all technical deliverables
- o Preparation and review of all corporate QA/QC guidance documents

3.2 Site Management

Mr. James S. Chamness, RI Project Supervisor, is directly responsible for all field activities at the Medley Farm Site. He will be involved in the initial mobilization activities and will maintain daily contact with field personnel during the course of the project.

An on-site coordinator will be selected by the Project Manager and RI Project Supervisor for each task or set of tasks that will be performed concurrently during the RI. The on-site coordinator will manage field operations and is responsible for implementation of health and safety procedures, restricting site access during the course of the work, and utility clearances. The on-site coordinator will report directly to the RI project supervisor and interact directly with the project health and safety coordinator.

The on-site coordinator will generally be the project field geologist who will also be directly responsible for data collection activities. The on-site coordinator will be familiar with all aspects of the POP and will confirm sampling activities and locations with the RI project supervisor.

Experienced technicians will be utilized for support activities including equipment decontamination and field calibration, operation of field screening instrumentation, sample packaging and shipment and assistance with documentation of field activities.

4.0 QUALITY ASSURANCE OBJECTIVES

The procedures described herein are designed to obtain precise and accurate data for each analytical method and analysis. To ensure that reliable data continues to be produced, systematic checks must show that test results remain reproducible and that the methodology is actually measuring the quantity in each sample. Quality assurance must begin with sample collection and not end until the resulting data have been reported.

All laboratory sampling data will be generated by Radian Laboratory, which is under the EPA Contract Laboratory Program (CLP). EPA-approved contract laboratories have an in-place program for data reduction, validation and reporting, as discussed in Section 9.0. The reliability and credibility of analytical laboratory results can be corroborated by the inclusion of a program of scheduled replicate analyses, analyses of standard or spiked samples, and, as necessary, the cooperative analyses of split samples with EPA laboratories. Regularly scheduled analyses of known duplicates, standards, and spiked samples are a routine aspect of data reduction, validation, and reporting procedures.

4.1 Quality Assurance Measurements

Specific quality assurance measurements will be addressed to satisfy the quality assurance objectives. These measurements include the following:

Data Quality

The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability. These characteristics and other important items are defined as follows:

- o Accuracy - the degree of agreement of a measurement, X , (or an average of measurements of the same thing) with an accepted reference or true value, $X-T$, or the difference as a percentage of the reference or true value, $100 (X-T)/T$, and sometimes expressed as the ratio X/T . Accuracy is a measure of the bias in a system.

- o Precision - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions."
- o Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.
- o Representiveness - the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- o Comparability - the confidence with which one data set can be compared to another.
- o Data Validation - a systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verification, certification, and review.
- o Environmentally Related Measurements - a term used to describe essentially all field and laboratory investigations that generate data involving (1) the measurement of chemical, physical, or biological parameters in the environment, (2) the determination of the presence or absence of criteria, or contaminants in sample matrices, (3) an assessment of potential health and ecological effects, (4) the performance of engineering and process evaluations, (5) the study of laboratory simulation of engineering or environmental events, and (6) the study or measurement of contaminant transport and fate, including mathematical diffusion models.

- o Quality Assurance - the total integrated program for assuring the reliability of monitoring and measurement data. A system for integrating the quality planning, quality assessment, and quality improvement efforts to meet user requirements.
- o Quality Assurance Program Plan - an orderly assemblage of management policies, objectives, principles, and general procedures by which an agency or laboratory outlines how it intends to produce data of known and accepted quality.
- o Quality Control - the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

4.2 Data Representativeness

The methods to be employed for obtaining representative samples are described in Section 5.0 of this document. Generally, the guidance for sampling protocol will be the U.S. Environmental Protection Agency document, Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual: Region IV, Environmental Services Division (April, 1986), as amended.

4.3 Data Comparability

Data collected from various locations on the site should be sampled and analyzed in such a way that the results can be compared. The sampling procedures will be identical from one sample to the next in the same media. The sample analyses to be performed by Radian will be the analytical methods specified by the CLP, as discussed in Section 8.0. Data taken in the field for sample screening will be comparable within a procedure, since all screening will follow the methods discussed in Section 7.0.

4.4 Quality Assurance Procedures

- o Duplicate Analyses:

A number of the samples submitted to the laboratory will be collected and analyzed in replicate (duplicate). Analysis of duplicate samples determines the precision of sampling equipment and technique. Samples for duplicate analyses will be selected at random by the field manager and so designated at the time they are logged in. Samples for duplicate analyses will be designated by field personnel at the time of sample collection. Duplicate analyses will be performed for a minimum of one sample for each matrix or for five (5) percent of the total samples for each matrix, whichever is greater. Duplicate samples will be given identification that does not indicate the sampling location. This form of "blind" submittal helps ensure the unbiased analysis of duplicate samples. The rigorous quality assurance requirements given by the CLP combined with duplicate analyses will ensure the data integrity of samples analyzed during the RI.

- o Standard Quality Assurance Samples:

A standard quality assurance sample (spiked sample) is a known amount of an analyte in a consistent matrix prepared by an outside organization. This spiked sample provides information on the accuracy of the analytical method, but it will not give any information on matrix effects or natural background levels of the analyte. All spiked samples will be provided by EPA's Environmental Services Division (ESD) in Athens, Georgia, as necessary.

- o Trip Blanks:

Trip blanks are defined as samples of contaminant-free water, already in sample containers that are carried to the site, stored and shipped to the laboratory with any investigative samples

collected. Trip blanks will be submitted to the laboratory for analysis at the rate of one trip blank per week of sampling. Trip blanks will be analyzed for volatile organic compounds, the most likely form of potential contamination. The true identity of the trip blank samples will be unknown to the laboratory. These samples will be provided by SEC.

o Split Samples:

The need for split samples will be determined through discussions between EPA's ESD and SEC. Samples split between the ESD laboratory and the Radian CLP laboratory will provide a check of the analytical procedures of the Radian laboratory. Samples split between laboratories will be logged in and identified as such. They will be analyzed along with regular samples.

5.0 RI SITE INVESTIGATIONS

5.1 OVERVIEW

The Remedial Investigation of the Medley Farm site will be conducted to determine and document the presence or absence, extent, and type of residual contamination which may be present at the Medley Farm site and to investigate the potential migration of contaminants offsite. The results of this study will be used to evaluate the necessity for further remedial action at this site and to support the selection and design of remedial alternatives if required. If contamination is confirmed, public health impacts will also be evaluated.

All samples collected will be analyzed either by screening with field instruments or by a laboratory in EPA's Contract Laboratory Program. Sample collection procedures and protocols will be in general accordance with the EPA Region IV Standard Operating Procedures and Quality Assurance Manual (SOPQAM), dated April 1, 1986, unless described otherwise herein. Any modifications or changes will be documented before the actual field work begins or in the field logbook, if changes are required in the field.

5.1.1 Data Quality Objectives

Data Quality Objectives (DQOs) are based on the concept that different data uses may require different data quality. Two (2) levels of analytical data quality, as summarized on Table 4-3 of the document Data Quality Objectives for Remedial Response Activities (EPA 540/G-87/003), will be generated and utilized during this Remedial Investigation:

- o Level I (screening); this analytical data quality level is acceptable for general site characterization and health and safety monitoring during implementation of sampling activities. Organic vapor analyzers will be utilized for health and safety monitoring and sample screening during all sample collection activities for this project. The soil gas survey is also considered Level I.

- o Level IV (confirmational); this analytical data quality level requires full Contract Laboratory Program (CLP) analytical and data validation procedures. This quality of data is suitable for the evaluation and design of remedial alternatives and for risk assessment. To meet the objectives of this RI/FS, all samples of surface water, sediment, soil and ground water subjected to laboratory analysis during this study will be collected and analyzed at the CLP level.

5.1.2 Summary of Field Investigations and Sampling Activities

The RI field investigations will be conducted in a series of phases to allow for adequate evaluation of data collected in each step and for re-assessment of proposed sampling locations and analytical parameters. The break between Phase IA and Phase IB will be for the evaluation of TCL analyses, serving as a source characterization, and the development of a site-specific list of indicator parameters.

The proposed type and quantity of field activities for Phase IA and Phase IB of the Remedial Investigation are given in Table 5.1. Based on the initial information on the site, these appear adequate to characterize the site. The need for Phase II activities will be based on the results of Phase I and the extent of potential contamination.

5.1.3 RI Analytical Requirements

The analytical program proposed for the Medley Farm site RI field investigation includes ground water, surface water, stream sediment and soils analyses. The RI sampling and analytical program for this site is summarized on Table 5.2. The result of chemical analyses conducted during the initial phase of the Remedial Investigation (Phase IA) will be used to develop a set of indicator parameters which will be used for subsequent analyses conducted during the Remedial Investigation. Indicator chemicals will represent the major analytical fractions identified in the Phase IA

TABLE 5.1

SUMMARY OF PHASE I FIELD ACTIVITIES DURING
THE REMEDIAL INVESTIGATION

<u>ACTIVITY/INSTALLATIONS</u>	<u>QUANTITY</u>	
	<u>PHASE IA</u>	<u>PHASE IB</u>
Shallow Ground Water Monitoring Well	4	0
Bedrock Ground Water Monitoring Well	4	0
Soil Gas Survey Receptors	115	0
Test Pits	8	7
Soil Borings	0	12
Surface Water Sampling	0	4
Sediment Sampling	0	4
Hydraulic Testing		
Slug Tests	4	0
Pressure Tests	4	0
Pump Tests	0	1
Bedrock Corings	4	0
Soils Analyses		
Moisture Content	12	24
Sieve Analysis	8	12
Hydrometer Analysis	4	0
Atterberg Limits	8	6

TABLE 5.2

SUMMARY OF PHASE I SAMPLING AND ANALYTICAL
REQUIREMENTS DURING THE REMEDIAL INVESTIGATION

<u>SAMPLE TYPE</u>	<u>TCL</u>	<u>DIOXINS</u>	<u>INDICATORS</u> ¹
Ground Water Samples			
Phase IA	4	0	0
Phase IB	0	0	8
Soil Samples			
Phase IA	8	0	0
Phase IB	0	1 ³	31 - 43 ²
Surface Water Samples			
Phase IA	0	0	0
Phase IB	0	0	4
Sediment Samples			
Phase IA	0	0	0
Phase IB	0	0	4

Notes:

1. The need for additional sampling and analyses will be assessed at completion of this analytical program.
2. The total number of analyses is dependent on the results of initial analyses as described in Section 3.7.1. Metals and pesticides will be included in analyses conducted on soil samples obtained from one boring drilled at an appropriate "background" location.
3. One sample will be collected from each test pit (15 samples) as they are excavated and stored at the laboratory for potential dioxin analysis. After reviewing the results of all other test pit analyses, two (2) selected samples will be composited and one (1) composite sample will be sent to the laboratory and analyzed for dioxins by CLP Special Analytical Services (SAS).

source characterization and be selected for EPA's approval in accordance with guidelines established in the Superfund Public Health Evaluation Manual (EPA/540/1-86/060). This document defines indicator parameters as chemicals chosen to "represent the most toxic, mobile and persistent chemicals at the site, as well as those present in the largest amounts." This list will be finalized prior to subsequent sampling and analyses.

Samples which will be used to develop the Medley Farms site-specific list of indicator parameters are:

- o Ground water samples (4) collected from monitoring well pairs installed at MW-2 and MW-4 (Figure 5.5).
- o Soil samples taken at test pits excavated in former lagoon areas (Figure 5.3).

Analytical methods and sample preservation, container type, volume and holding time requirements will be in accordance with the CLP Routine Analytical Services (RAS).

5.1.4 Site Security

The objectives of site security during the field investigation are as follows:

- o Control access to the site during the RI
- o Prevent vandalism and/or theft of equipment

There are no gates or fences which can be locked to prevent unauthorized entry to this site. Any persons attempting to enter the site during working hours must be authorized by the on-site coordinator and will be requested to sign in and state his or her purpose, date and time of arrival and departure. Persons wishing to enter the site during the RI should have the approval of SCDHEC and/or EPA. During off hours, the Cherokee County Sheriff's Department will be requested to observe the site during their patrol.

At all times during the progress of the work, precautions shall be taken to prevent access to monitoring wells by unauthorized personnel. Temporary measures used to prevent access when incomplete wells are left unattended due to construction schedules will be documented in the field logbook.

5.1.5 Potable Water Supply

Potable water will be needed during the field investigations for equipment decontamination, grout preparation and bedrock coring. Potable water will be obtained from the nearest treated municipal supply and brought in by tank truck and stored onsite. Available sampling records will be collected on the water source prior to its use in field activities.

5.1.6 Health and Safety Procedures

Health and safety procedures which will be implemented during the scheduled field activities identified in this POP are described in Appendix A; Medley Farm Site RI/FS Health and Safety Plan.

5.1.7 Equipment Decontamination

5.1.7.1 Decontamination Areas

Large equipment and drilling tools will be cleaned in areas specifically designated for this purpose. These areas will be located in existing shallow depressions or will be isolated by the construction of perimeter berms to contain wash water which will be allowed to percolate into the soil. Decontamination sites will be located in areas where near surface soils are expected to be contaminated based on preliminary source characterization efforts. The boundaries of decontamination areas will be surveyed and included on the site plan.

5.1.7.2 Equipment Cleaning and Handling Procedures

Equipment and materials used for test pit excavation, soil or rock drilling, monitoring well installation and development or hydraulic testing will be cleaned and handled in accordance with the following guidelines:

1. Backhoes, drill rigs and all support equipment shall be free from excess grease, oils, and caked-on soils from previous work prior to arrival at the site. Equipment which leaks fuel, coolant, and lubricants shall be removed from the site and repaired prior to use.
2. The work area of drill rigs and all downhole tools and equipment shall be cleaned with high pressure steam cleaning equipment using potable water from a treated municipal supply at the commencement and completion of the work and between boring or well locations. Backhoes used for test pit excavation shall be cleaned in the same manner.
3. All well casings, screens, centralizers, tremie pipe, measuring lines, etc., shall be steam cleaned prior to well installation.
4. Equipment or materials not used immediately after decontamination will be placed on a plastic sheet, covered with plastic and secured to avoid potential contamination.
5. Equipment such as pumps, flow lines, etc. will be flushed thoroughly with potable water from a treated municipal supply prior to use.

All sampling equipment and instrumentation will be cleaned at the SEC laboratory according to the laboratory procedures prior to travel to the site. Field equipment and instrumentation includes: pH and specific conductivity meter probes, tape measures, weights, water level indicator tape and probe, etc., mixing bowls, hand augers and trowels, purge pumps, etc.

Field equipment and instrumentation which will be used at multiple sampling locations will be cleaned according to the following field cleaning procedures:

1. Clean with tap water and phosphate-free laboratory detergent, (Liquonox or equivalent) using a brush if necessary to remove particulate matter and surface films.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized or distilled water.
4. Rinse two times with pesticide grade isopropanol solvent and allow to air dry for as long as possible (except meter probes).
5. Rinse thoroughly with deionized or distilled water and allow to air dry for as long as possible.
6. Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is to be stored or transported.

An alternate decontamination procedure will consist of steam cleaning instead of steps 2 through 5 above. Personnel involved in removing and preserving soil samples for chemical analysis will wear surgical inner gloves with nitrile outer gloves. Outer gloves will be washed with soapy water and rinsed with distilled or deionized water immediately prior to collecting each sample.

Isopropanol used for decontamination will be collected and allowed to evaporate. Any residual isopropanol that remains unevaporated will be properly packaged and disposed of in accordance with applicable regulations. Spent decontamination solutions will not be allowed to flow offsite.

5.1.7.3 Disposable Items

All disposable items (i.e., Tyvek, gloves, etc.) or other items which cannot

be adequately decontaminated will be containerized on site in 55 gallon drums and disposed of appropriately after all site activities have been completed.

5.2 SITE SURVEYING AND TOPOGRAPHIC BASE MAP

Thirteen ground control stations were established and an aerial survey of the site and surrounding area was conducted by Bell Mapping Company of Winston-Salem, N.C. during April, 1988. A topographic base map encompassing an area 4000 feet (north-south) by 3000 feet, with the disposal area situated approximately 600 feet northwest of center, was photogrammetrically produced. This area of coverage was selected to include significant surface drainage features surrounding the site and the property surrounding the sprouse well. This base map which has a scale of 1 inch equals 100 feet with a 2-foot topographic contour interval is included as Figure 5.1. This topographic map will be used as a base for RI/FS report figures.

After all subsurface explorations have been completed sampling locations and elevations will be determined by a surveyor licensed in the state of South Carolina. Monitoring well elevations will be surveyed to a marked reference point on the well riser casing. Monitoring well installation permits will be obtained from SCDHEC prior to any installations and all information will be properly reported to the agency.

All surveyed points will be referenced to the state planar coordinates and the National Geodetic Vertical Datum (NGVD), 1929.

5.3 FRACTURE TRACE ANALYSIS AND AERIAL PHOTOGRAPH INTERPRETATION

The aerial photographs taken for the preparation of the site topographic plans will be examined in conjunction with the topographic base map to identify linear features which may be surface expressions of vertical or nearly vertical fractures in the underlying bedrock. Identification of fracture traces will provide further data for the interpretation of probable ground water flow directions and potential pathways for contaminant migration. Although major lineaments can be identified on available

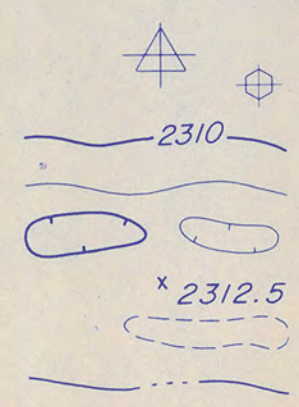
DATE OF PHOTOGRAPHY 4-7-88



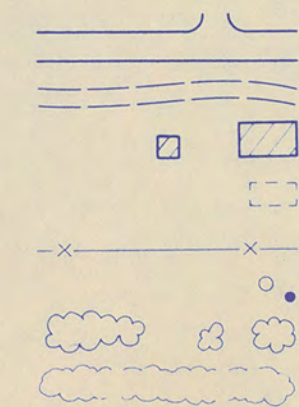
COMPILED PHOTOGRAMMETRICALLY BY
BELL MAPPING COMPANY — WINSTON-SALEM, N.C.

LEGEND

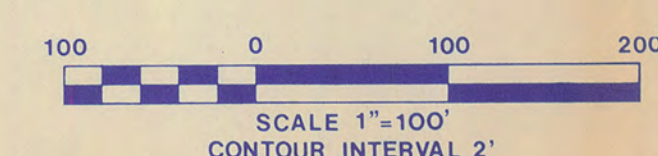
HORIZONTAL CONTROL POINT
VERTICAL CONTROL POINT
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
SPOT ELEVATION
PILE
WATER



IMPROVED ROAD
DIRT ROAD
BUILDING
LOCATED OBJECT
FENCE
POLE
TREES
BRUSH

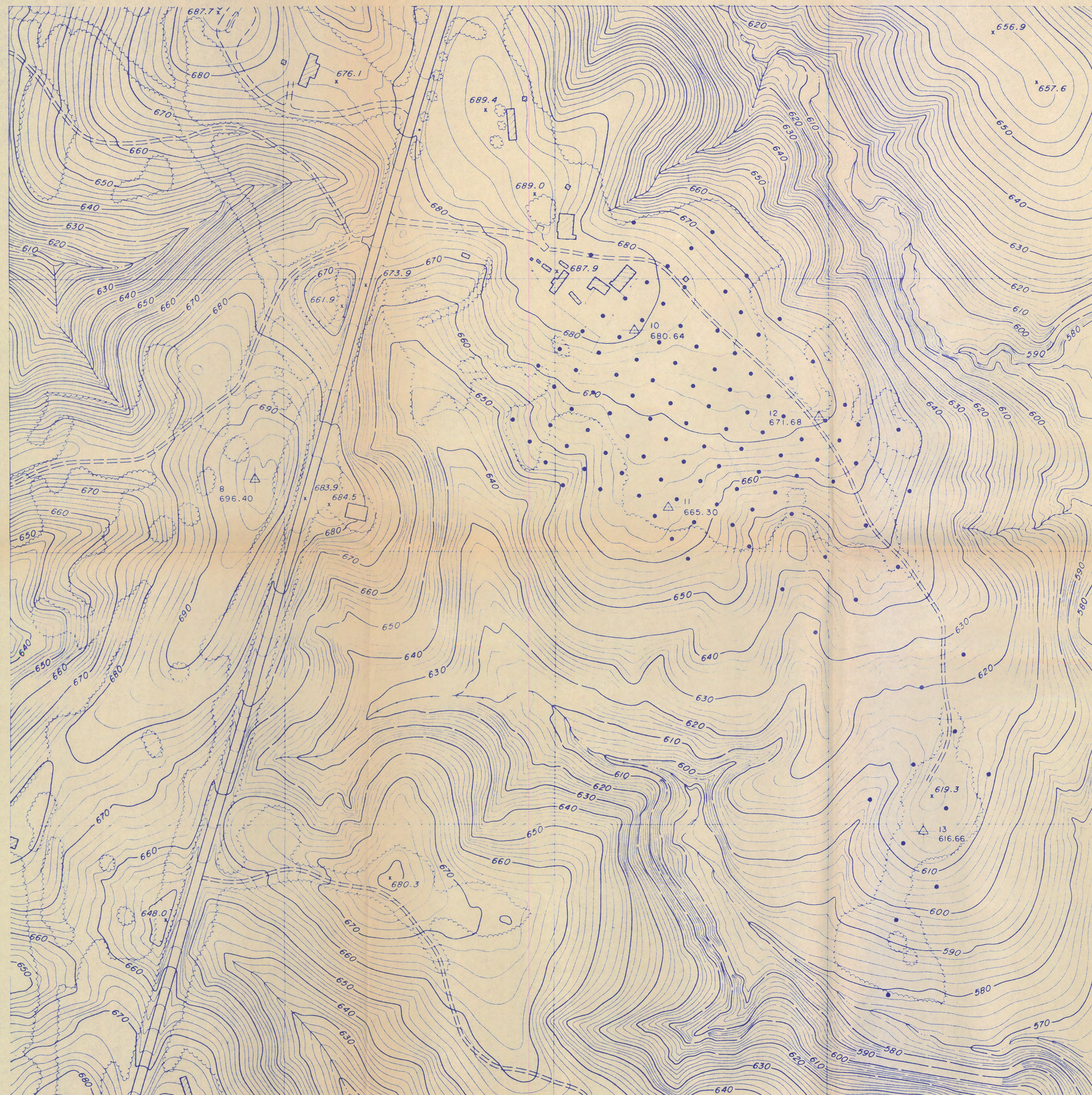


HORIZONTAL DATUM ARBITRARY - BASED ON NORTH
VERTICAL DATUM - MEAN SEA LEVEL
NATIONAL GEODETIC DATUM OF 1929



SIRRINE
ENVIRONMENTAL
CONSULTANTS

GAFFNEY SITE



LEGEND

PROPOSED SOIL GAS
SAMPLING LOCATION

HORIZONTAL CONTROL POINT

VERTICAL CONTROL POINT

INDEX CONTOUR

INTERMEDIATE CONTOUR

DEPRESSION CONTOUR

SPOT ELEVATION

PILE

WATER

IMPROVED ROAD

DIRT ROAD

BUILDING

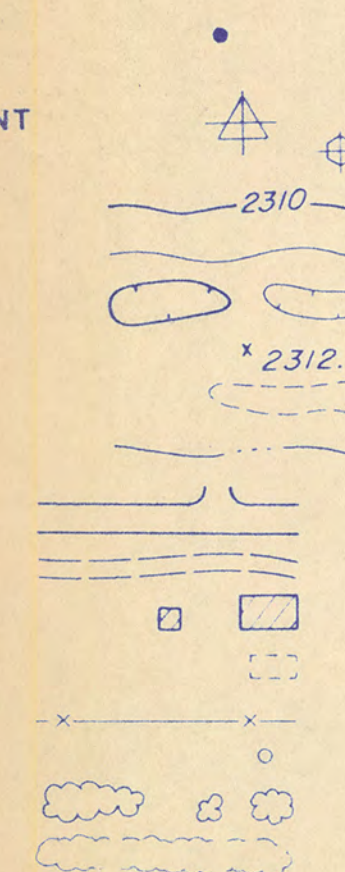
LOCATED OBJECT

FENCE

POLE

TREES

BRUSH



NOTES

HORIZONTAL DATUM ARBITRARY -
BASED ON NORTH

VERTICAL DATUM - MEAN SEA LEVEL

NATIONAL GEODETIC DATUM OF 1929

COMPILED PHOTOGRAMMETRICALLY BY
BELL MAPPING COMPANY
WINSTON-SALEM, N.C.

DATE OF PHOTOGRAPHY 4-7-88

REV.	NO.	CODE	CIRCLES	DATE	DESCRIPTION	SEC. APPROVED
REV.	BY					
NOTE:					CIRCLE ALL REVISIONS, IDENTIFY WITH DIAMOND, NUMBER AND ARROW REMOVE ONLY CIRCLE AND ARROW BEFORE NEXT REVISION.	
ISSUE CODE	C	MAT'L T.O.	F	CONSTN		
A PRELIMINARY	D	MAT'L PURC.	G			
B DESIGN	E	RIDS	H			

SEAL

SIGNATURE

DATE

DR.	DATE 10/6/88
DSGN.	SEC FILE
CK.	NUMBER
DPE	JOB NO. G-8026
CAD FILE NO.	



Greenville, South Carolina

MEDLEY FARM SITE

GAFFNEY , S.C.

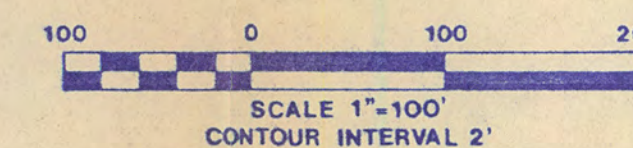
DRAWING TITLE

FIGURE 5-2

PROPOSED SOIL GAS
SURVEY GRID

CLIENT DRAWING NUMBER

SEC DRAWING NUMBER



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Sirrline Environmental Consultants, Inc.

1:24,000 U.S.G.S. topographic maps, smaller scale features which may be present should be discernable on the aerial photographs and the larger scale topographic map. This information will be used to refine proposed monitoring well locations. The aerial photographs will also be examined for any evidence of stressed vegetation or other features which might augment source characterization.

5.4 SOIL GAS SURVEY

5.4.1 Objectives and Schedule

A soil gas survey will be conducted prior to all other RI subsurface investigation and subsurface sampling efforts. The primary purpose of the soil gas survey is to determine the presence and extent of residual soil contamination which may be present although some information pertaining to ground water contamination may be obtained depending on depths to ground water and the levels of contaminants which may be present in the ground water beneath the site. Since existing data indicates that volatile organics are the primary and most mobile contaminants of concern at the site, this technique will be used as a screening tool to select optimum locations for direct sampling sites. Data generated from the soil gas analyses will be used in conjunction with the existing data base to finalize locations for test pits, soil borings and ground water monitoring wells. The results of chemical analyses performed on soil samples collected from test pits will be used to confirm interpretation of the soil gas survey results.

5.4.2 Sampling Locations and Frequency

Soil gas collectors will be installed at a total of 115 locations at the site. The sampling locations are based on a rectangular grid system with sample spacings varying from 50 to 100 feet. The densest portion of the grid system (50' centers) is located in the old drum storage and lagoon areas. This should enable delineation of source areas and identification of potential migration pathways within these areas. The surrounding area is covered with an 100' reconnaissance grid in order to establish the location of background areas along with downgradient migration pathways.

The proposed soil gas sampling grid is shown on Figure 5.2. The eventual number and position of soil gas receptors may vary depending on conditions encountered in the field.

5.4.3 Task Team and Responsibilities

On-site Coordinator - Field/office liaison

- Confirmation of sampling locations
- Subcontractor coordination

Subcontractor - Installation, collection and analysis of soil gas samplers

5.4.4 Equipment and Procedures

The patented PETREX passive soil gas technique will be used to provide time integrative soil gas collection, thereby minimizing the effects of short-term environmental variables (precipitation, evapotranspiration, etc.) while facilitating the collection of representative soil gas samples in the clayey residual soils present at the site.

The soil gas survey will be subcontracted to PETREX, a Division of Northeast Research Institute Inc. (NERI) of Farmington, Connecticut. All soil gas collectors and necessary equipment will be provided by PETREX. Analyses will be performed at the NERI analytical laboratory in Farmington, Connecticut.

The PETREX collector consists of a ferromagnetic wire coated with an activated adsorbent. Each sampler is placed in a shallow hole, 18-24 inches deep, within a protective container. The hole is backfilled and the location is marked. Additional collectors are installed for calibration at sites selected in the most probable source areas. These collectors are retrieved periodically and checked to determine the time period required (the total time collectors will be left in place) for the successful application of this technique at the site. Ten receptors will be used for time calibration.

The collectors are typically left in the ground for 2-4 weeks, then retrieved and sealed for transportation back to the laboratory for analysis. In the laboratory, the compounds are desorbed from the wire, ionized, separated according to mass, counted, and ion counts for each mass from 29 to 240 are reported.

The ion count data (relative intensities) of indicator peaks for the specified compounds identified is computerized. Ion count data are extracted from the original data file and processed for identification. Compound identification is accomplished by comparing mass spectra from the survey collection data set to an extensive reference library of mass spectra of pure compounds and common compound mixtures. The resultant data will then be presented in the form of isopleth contour maps based on the ion count flux data for each selected compound or mixture identified at each sample location.

It should be noted that indicator peak intensity is not a measure of concentration but rather an expression of the relative amount of a compound collected at a given location. Sample locations are shown with the corresponding relative ion count levels which relate to varying compound concentrations in the subsurface. Only relative differences in subsurface compound concentrations can be inferred from the relative ion count values for a given compound.

The sampling grid will be laid out in the field using a Brunton Pocket Transit or comparable instrument. Every effort will be made to adhere to the proposed locations; however, some locations may be adjusted to avoid topographical obstacles.

5.4.5 PETREX Quality Assurance/Quality Control Procedures

5.4.5.1 Wire Preparation

1. Adsorption wires (after construction) are cleaned by heating to 358 degrees C in a high vacuum system.

2. Wires are packed under an inert atmosphere in airtight tubes.
3. One collector out of every thirty is checked for cleanliness by mass spectrometry. Based on the results, the group of thirty collectors is approved for release into the field.

5.4.5.2 Sampler Shipment and Field Handling

1. Five percent transportation blanks are included with each shipment. Transportation blank is stored unopened until analysis with the field samplers.

5.4.5.3 Mass Spectrometer Tuning

1. An Extranuclear Quadrupole Mass Spectrometer equipped with a Curie-point pyrolysis/thermal desorption inlet is used for collector analysis. Mass assignment and resolution are manually adjusted using a Perfluorotributylamine (PFTBA) standard. A linear correction, based on the known spectrum of PFTBA, is calculated. This correction is applied to a second PFTBA spectrum. If correct mass (M/Z) values are obtained, the operator proceeds to the next tuning step. If not, Step 1 is repeated until correct masses are obtained.
2. Peak intensity ratios are set from the major peaks in the PFTBA spectrum using the following values:

<u>Mass (M/Z)</u>		<u>Spectrum Intensities</u>
69	=	100%
131	=	25% ± 5%
219	=	35% ± 5%

3. During tuning the ion signal for mass (M/Z) 69 of PFTBA is measured at a present sample pressure and detector voltage and compared to previous values at the same settings.

4. Electron energy is set to 15 electron volts and emission is set at 12 milliseconds. All other operating parameters, such as scans, scan range, mass offset are established in the computer program. These values can only be changed by the laboratory manager.
5. Tuning is only performed at the beginning of a run, so that an individual survey is analyzed at the same set of instrument conditions. The samples are analyzed in random order.

5.4.5.4 Mass Spectrometer Analysis

1. Periodic (approximately every 20 samples) machine background analyses are performed to assure that there is no carry-over between successive samples. If there are peaks that are not related to atmospheric gases, the supervisor is notified and the mass spectrometer is shut down and cleaned as necessary.
2. A written sample number record is kept during the analysis to prevent accidental cross numbering.
3. The mass spectrometer control program contains appropriate "flag statements" that prompt the operator with a warning if an input sample number has already been analyzed. The operator then checks the current number, along with the disk storage location of the previously entered number to identify the true numbering situation.

5.5 TEST PIT EXCAVATION AND SAMPLING

5.5.1 Objectives and Schedule

Test pits will be excavated to provide initial source characterization in and around the former lagoon and drum storage areas. The objective of source characterization is to determine the potential presence and remaining concentrations of residual contaminants, if any, at each of the known and suspected disposal and storage areas. This information will be used primarily to evaluate alternatives for source control. Test pits will allow

sampling and direct visual characterization of any residual wastes which may be present and assessment of former lagoon bottom conditions.

A total of 15 test pits will be excavated during the RI. Eight (8) of the proposed test pits will be excavated during Phase IA to collect samples which will be used to develop the site-specific indicator parameter list. The remaining seven (7) test pits will be excavated during Phase IB based on the findings of Phase IA.

5.5.2 Sampling Locations and Frequency

Six former lagoons have been tentatively identified from previous site investigations. Eight (8) test pits will be excavated during Phase IA at the six lagoon areas (two pits at the two largest lagoons), as shown in Figure 5.3. Alternate locations will be submitted to EPA for approval if the given locations cannot be confirmed through site reconnaissance or the soil gas survey. Seven (7) additional test pits will be excavated during Phase IB. Six (6) of the Phase IB test pits will be located at potential sites of residual soil contamination identified during the soil gas survey. The last test pit will be located at the electromagnetic anomaly referred to in the conclusions of the NUS geophysical study report as a potential "buried drum" location. The location of this test pit is also shown in Figure 5.3. One composite soil sample will be selected for laboratory analysis from each test pit.

5.5.3 Task Team and Responsibilities

On-site Coordinator/Field Geologist - Field/office liaison

- Confirmation of excavation and sampling locations
- Test pit logging
- Overall technical oversight
- Subcontractor coordination

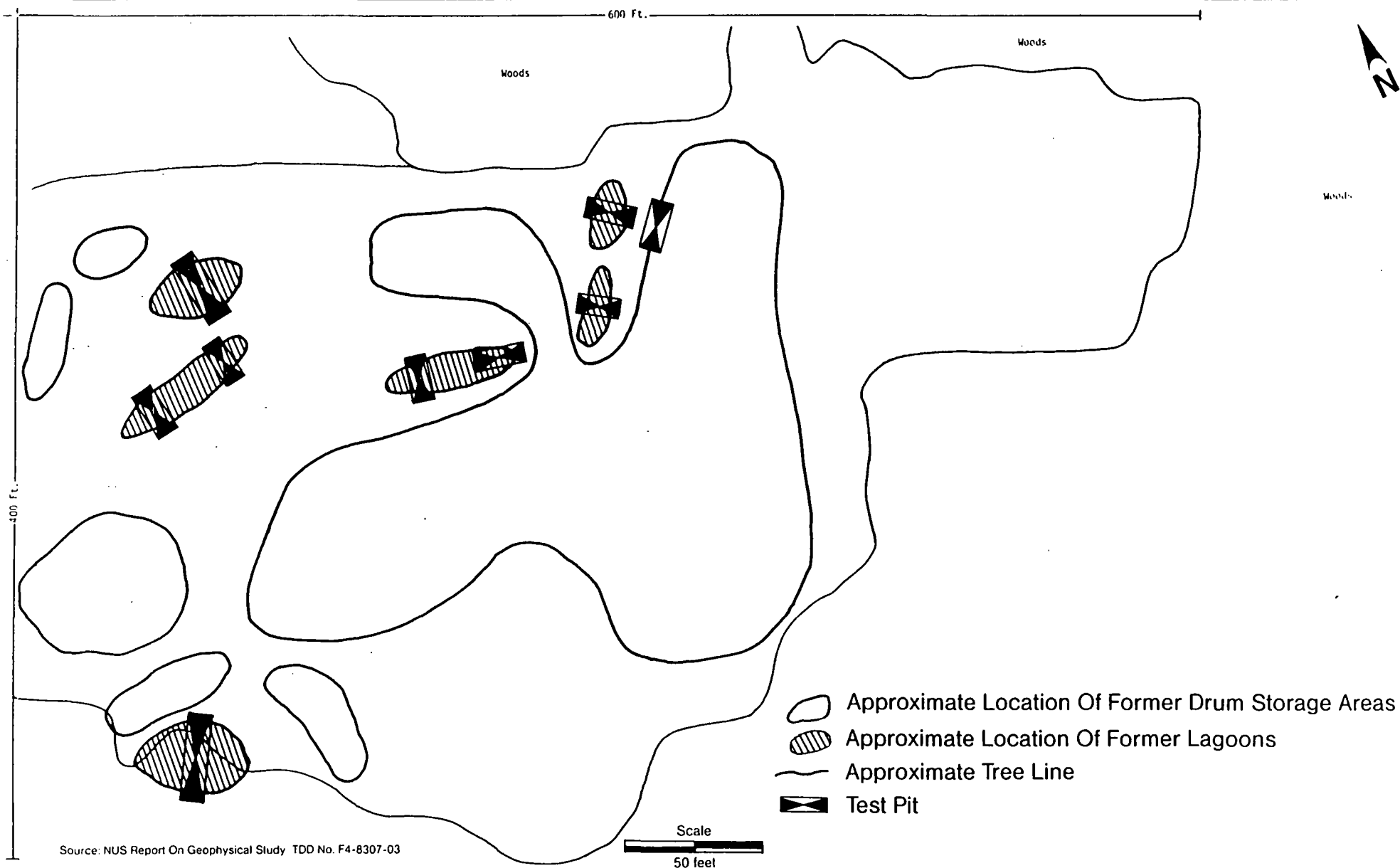


Figure 5.3
Proposed Test Pit Locations
Medley Farm Site
Gaffney, South Carolina

Technician

- Health and safety screening
- Assistance with record keeping
- Sample packaging and shipment

5.5.4 Equipment and Procedures

Equipment required for this task includes:

- o Backhoe
- o Decontamination equipment and supplies
- o Field logbook
- o Camera
- o OVA or HNu
- o Level C health and safety equipment
- o Sample containers
- o Stainless steel or teflon sampling scoops
- o Glass or stainless steel mixing bows
- o Camera

The test pits shall be excavated with a standard backhoe in accordance with Section 8.2 of "A Compendium of Superfund Field Operations Methods" (EPA/540/P-87/001). The final orientations and dimensions of test pits will be determined in the field based on observed conditions. Minimum test pit dimensions will be approximately 12 feet x 4 feet x 10 feet (l' x w x d). Test pits located at former lagoon sites will be excavated to the depths required to fully penetrate fill placed during the emergency response action so that the underlying soils can be observed and sampled.

Four (4) grab samples shall be collected from the natural soils (fill placed during the emergency response action will not be sampled) excavated from each test pit. The grab samples from each test pit will be combined in the field by mixing in a glass or stainless steel pan to form one composite sample from each test pit for analysis. The grab samples shall be combined by mixing with a stainless steel spoon as described in Section 4.6.3.3.4 of the USEPA Region IV SOPQAM (1986). One (1) discrete grab sample will also

be collected from each test pit for the analysis of volatile organic constituents.

All samples collected from the test pits shall be selected from the most heavily contaminated soils exposed in each test pit, based on the results of screening with an organic vapor analyzer (OVA, HNu, or TIP II) and visual assessment. The samples shall be carefully selected from the material removed by the backhoe to assure that material which has come into contact with the backhoe bucket is not included. In addition, soil selected for sampling shall be trimmed with a stainless steel or teflon scoop prior to final sample collection. A separate stainless steel scoop shall then be used to collect the sample.

Soil samples collected from the eight (8) test pits excavated during Phase IA will be subjected to TCL analyses. Soil samples collected from the seven (7) test pit excavated during Phase IB will be analyzed for the indicator parameters identified at the completion of Phase IA.

Each test pit will be logged in the field book. Data recorded will include:

- o Name and location of job
- o Date of excavation
- o Approximate surface elevation
- o Total depth of excavation
- o Dimensions of pit
- o Method of sample acquisition
- o Type and size of samples
- o Soil and rock descriptions
- o Ground water occurrence
- o Organic vapor levels
- o Other pertinent information, such as waste material encountered

Final logs will be typed on the form included as Figure 5.4.

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TEST PIT NO. _____

PROJECT: _____
CLIENT: _____
CONTRACTOR: _____
EQUIPMENT USED: _____

JOB NO. _____

LOCATION: _____

ELEVATION: _____

DATE START: _____

DATE FINISH:_____

PREPARED BY: _____

[illegible]

After logging, each test pit will be photographed and backfilled. The approximate location and orientation of each test pit will be plotted on the field plan and the location will be staked for future reference.

5.5.5 Equipment Decontamination

All equipment shall be decontaminated in accordance with the procedures described in Section 5.1.7.

5.6 MONITORING WELL INSTALLATION

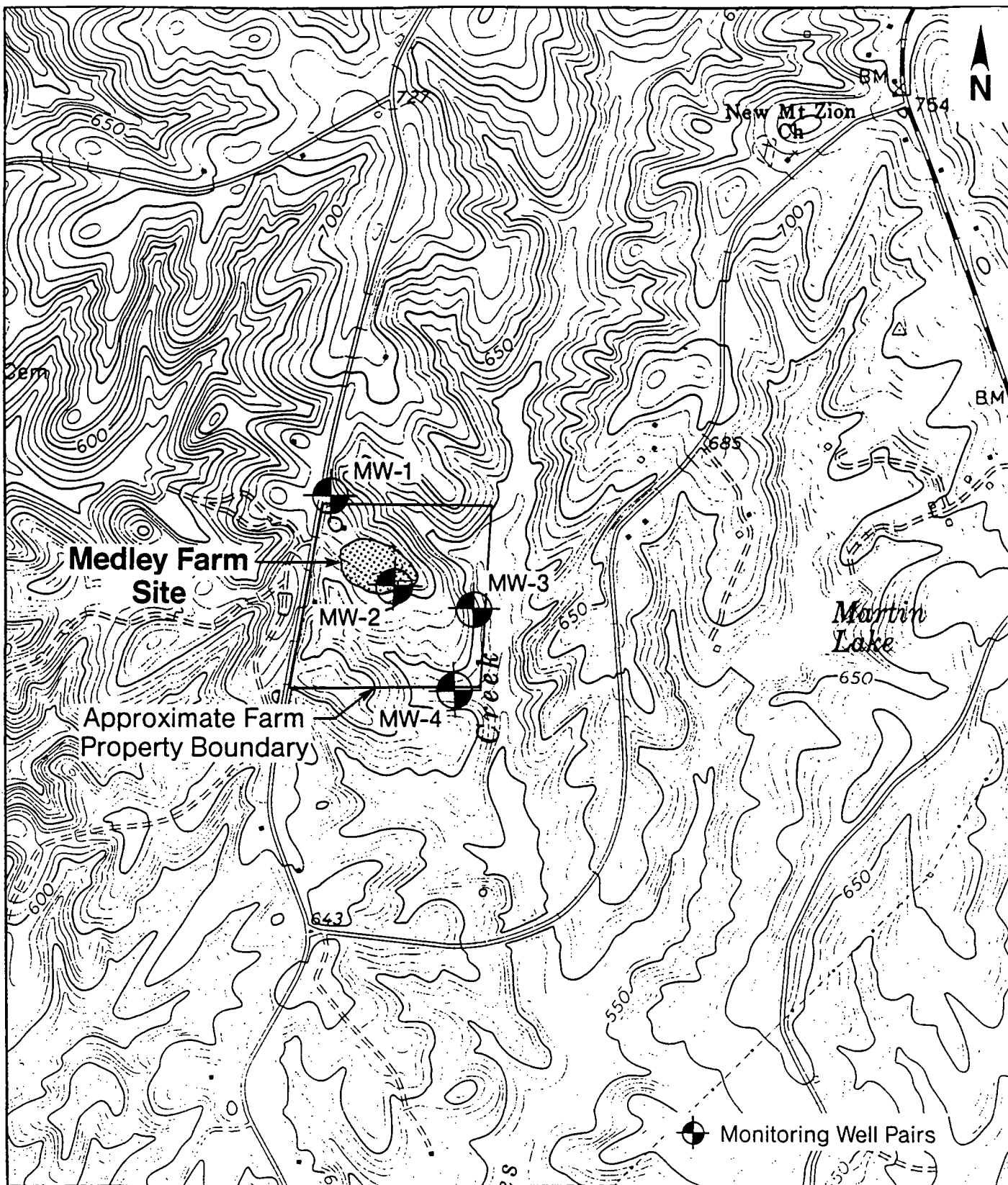
5.6.1 Objectives and Schedule

Eight (8) ground water monitoring wells will be installed during the Phase IA field effort to characterize the hydrogeology at the site and to investigate the potential presence and nature of ground water contamination. Monitoring wells will generally be installed in pairs consisting of a water table well and a deeper bedrock well, to investigate the vertical extent of potential contamination. In a case where no appreciable water was encountered above bedrock, only one well will be installed at that location.

5.6.2 Monitoring Well Locations and Construction Details

The four (4) proposed well-pair locations are shown on Figure 5.5. The rationale for the selection of these locations is presented briefly below:

- o MW-1; this well pair is approximately 400 feet northwest of suspected disposal activities, in the presumed upgradient direction. The location of the upgradient well will be determined in part using the results of the soil gas survey. The well pair was placed between the site and Sprouse well to confirm the private well contamination is not the result of site activities.
- o MW-2; this well pair is situated within the southeast boundary of the suspected disposal area. This location was selected to enable



USGS Pacolet Mills Quadrangle (1969)

Scale 1:14,100

Figure 5.5

Proposed Locations of Groundwater Monitoring Well Pairs

Medley Farm Site Gaffney, South Carolina



sampling of ground water immediately downgradient of former disposal and storage areas.

- o MW-3 and MW-4; these locations were selected to be downgradient from former site operations, along probable fracture traces which would constitute the most likely pathways for contaminant migration from the site.

These locations will be finalized after the soil gas survey data has been reviewed and the fracture trace analysis is completed using the 1 inch: 100 feet topographic site plan and aerial photographs.

A water table well and a deeper bedrock well will generally be installed at each location. The wells installed at each well pair location shall generally be spaced no greater than ten (10) feet apart. If ground water is not encountered in the saprolite at the proposed well pair locations, a single bedrock well will be completed to a depth of approximately 20 feet below the first occurrence of ground water at that location. The need for additional, deeper bedrock wells or alternate well locations will be assessed after completion of the Phase I RI field work. Where the water table occurs in the saprolite, the deeper well will be advanced to approximately 25 feet below auger refusal into the upper portion of the bedrock at a location adjacent to the saprolite well.

The saprolite well at each location will be abbreviated as SW and the bedrock well as BW for identification. The number of the well pair location will be maintained with the individual wells. For example, the bedrock well at well pair MW-3 will be called BW3.

Water table wells constructed in saprolite will consist of 15-foot-long, 2-inch I.D., type 304 stainless steel well screens set from approximately five (5) feet above to ten (10) feet below the water table. Screen slot widths shall generally be 0.010 inch unless grain size analyses of soil samples obtained from the adjacent boring for the companion bedrock well indicate that an alternate size should be selected. Sand packs will be constructed of washed silica sand compatible with the screen slot size such as Ottawa

sand (ASTM C190). Riser pipe will consist of National Sanitation Foundation Potable Water Grade, Schedule 40 PVC.

Bedrock wells will consist of four (4) inch I.D., type 304 stainless steel casing installed from ten (10) feet above the static water level encountered at the time of drilling to approximately five (5) feet into the bedrock (below auger refusal). Additional casing sections above the water level will consist of Schedule 40 PVC. A four (4) inch nominal diameter corehole will be drilled to approximately 20 feet below the bottom of the stainless steel casing. The cored sections will be left uncased to provide access for packer testing and ground water sampling.

Monitoring well installation permits will be obtained from SCDHEC prior to mobilization for well installation. Typical monitoring well construction details are included as Figure 5.6 and 5.7.

5.6.3 Task Team and Responsibilities

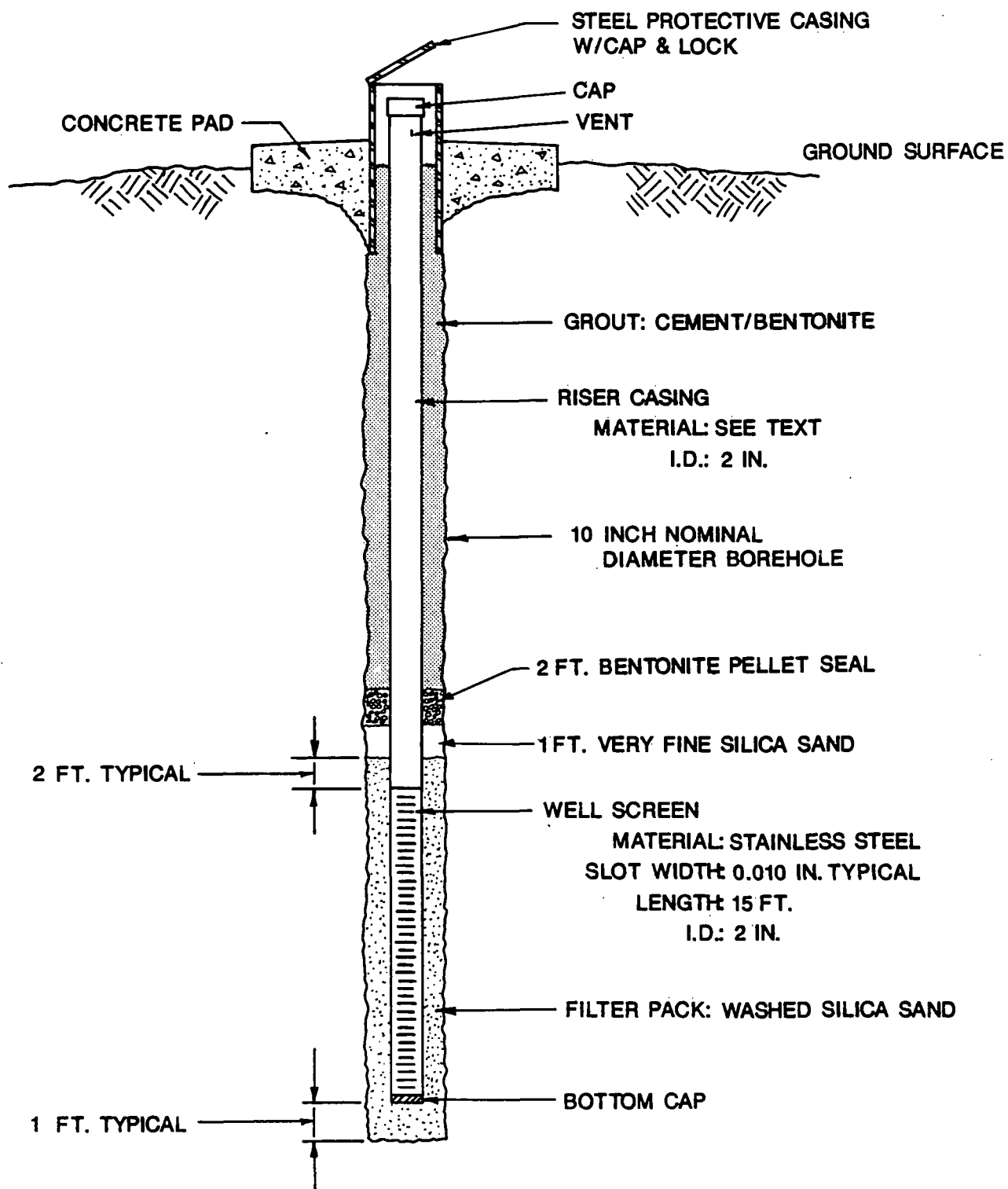
On-site Coordinator/Hydrogeologist - Field/office liaison

- Confirmation of well locations
- Log preparation
- Overall technical oversight
- Health and safety screening
- Subcontractor coordination

5.6.4 Equipment and Procedures

Equipment required for this task includes:

- o Drill rig and equipment
- o Decontamination equipment and supplies
- o Field logbook
- o OVA or HNu
- o Level C health and safety equipment

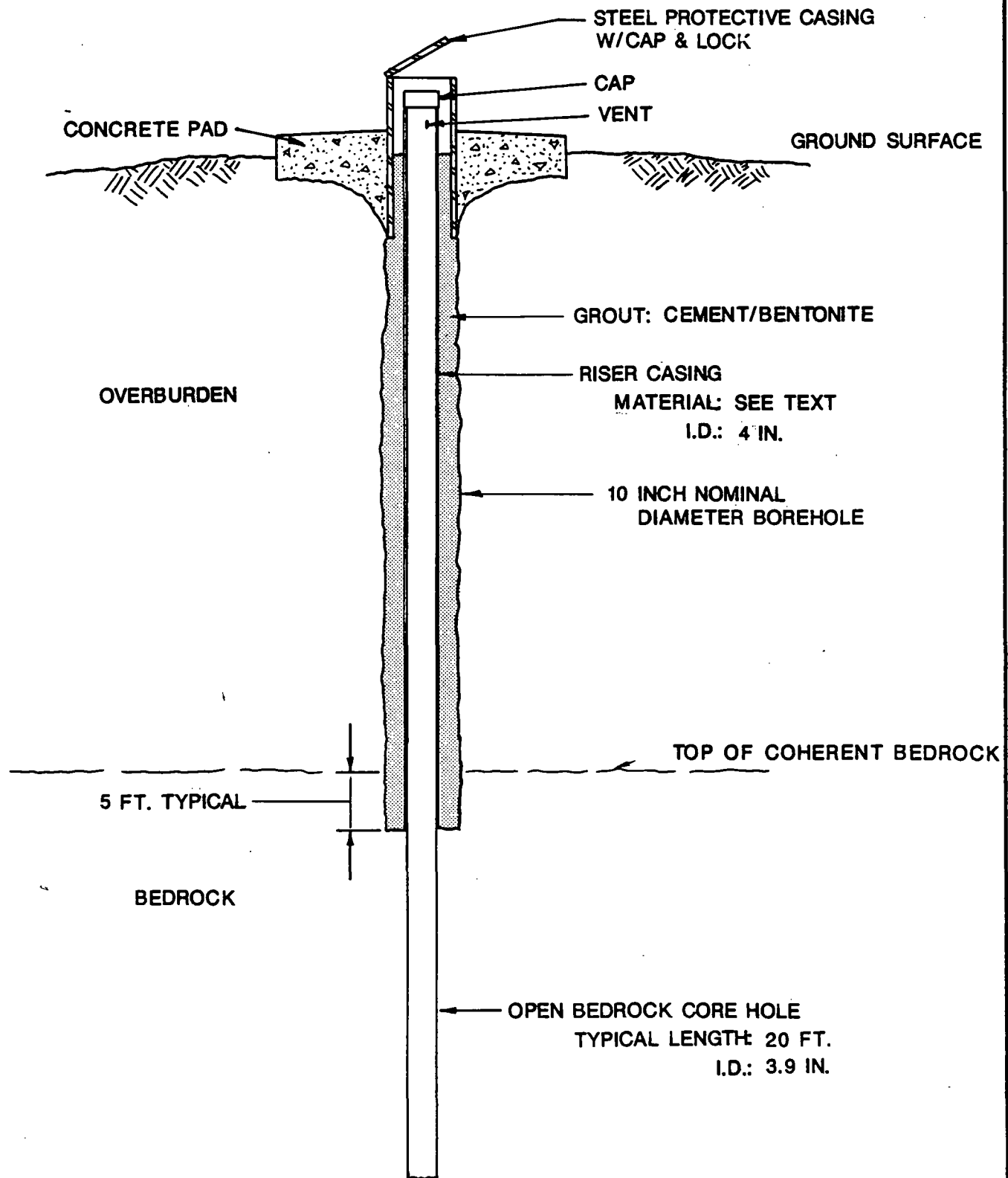


Greenville, South Carolina

MEDLEY FARM SITE RI/FS

TYPICAL MONITORING WELL DETAIL
SAPROLITE WELL

FIGURE 5.6



All drilling will be performed with conventional rotary drilling rigs fully equipped for dry auger and wet rotary drilling. An experienced geologist will continuously observe all drilling and well construction operations. All wells will be installed by a driller licensed in the State of South Carolina. No grease or oil shall be used on drill pipe joints, however teflon tape or vegetable oil may be used for lubrication.

Soil borings for monitoring well installation will be drilled using six-inch nominal I.D. (10 to 12-inch O.D.) hollow stem augers to provide ample annular space for quality well construction. A tri-cone roller bit or approved plug shall be maintained at the bottom of the augers, as they are advanced, to prevent cuttings from entering.

Soil samples for general site characterization will be obtained from one boring at each well pair location at 5-foot intervals using a standard 2-foot split spoon sampler driven in accordance with ASTM D-1586-67. In this manner the entire overburden thickness penetrated at each location will be sampled at 5-foot intervals. All soil samples will be identified in the field by an SEC geologist using visual/manual techniques described in ASTM D-2487 and D-2488. The soils will be classified in accordance with the Unified Soils Classification System and a log of each boring will be produced. Physical soils analyses will be conducted on selected samples obtained from these locations. The type and approximate number of tests to be performed is as follows:

<u>Test</u>	<u>ASTM Method</u>	<u>Estimated Quantity</u>
Natural Moisture Content	D-2216	12
Sieve Analysis	D-422	8
Hydrometer Analysis	D-422	4
Atterberg Limits	D-4318	8

All well materials will be steam cleaned immediately prior to installation. Clean, new disposable rubber gloves will be worn when handling well screens or casings. All well casing and screens will be transported to, and stored at the site in plastic wrap. Personnel handling these items will not handle tools or drilling equipment while installing the well.

The saprolite and bedrock wells will be installed as described below. Bedrock wells will be installed first so that the screen slot width and filter pack requirements of adjacent saprolite wells may be evaluated based on soil samples obtained while drilling the boring for the bedrock well.

Bedrock Wells

1. Advance the borehole with 6-inch I.D. hollow stem augers to auger refusal taking split spoon soil samples at five foot intervals. The moisture content of each soil sample will be visually assessed and noted on the log and frequent water level measurements will be taken through the augers to approximate the static water level at the time of drilling.
2. Remove the augers from the borehole.
3. Advance the borehole to a minimum of five (5) feet below auger refusal using a 10 inch minimum diameter tri-cone roller bit. Potable water will be used as a drilling fluid, however sodium bentonite may be added to stabilize the borehole and remove drill cuttings if necessary. The actual depth to which this portion of the borehole will be advanced will be determined in the field based on drill advance to assure that competent bedrock is penetrated.
4. Measure all casing sections required and record all measurements in the field logbook.
5. Assemble the necessary sections of 4-inch casing and lower the casing to the bottom of the borehole. Centralizers will be attached at 30 foot intervals at this time.
6. Fill the annular space between the casing and the borehole walls with neat cement grout installed through a tremie pipe set at the bottom. Grout will consist of not more than seven (7) gallons of potable water per 94-pound bag of Portland Type I Cement (ASTM C150). Approximately

3% (by weight) bentonite powder will be added to improve flow and reduce shrinkage.

7. After the grout has been allowed to set for a minimum of 24 hours, the casing will be flushed out to the bottom with potable water using a 3-7/8 inch tri-cone roller bit.
8. The borehole will then be advanced into the bedrock by coring. The bedrock will be cored using an H-series double tube core barrel. The corehole produced with this barrel will be approximately 4 inches in diameter. A core barrel with a split inner barrel will be used to recovery and facilitate assessment of the bedrock structure. Core runs will typically be five feet in length. Clear, potable water will be used as drilling fluid for coring. The volume of water pumped into the corehole while coring will be measured. Rock core recovered will be stored in 5-foot-long wooden core boxes until the project has been completed. The rock cores will be logged by a qualified SEC geologist. Logs will include detailed descriptions of bedrock lithology, grain size, texture, degree of weathering, hardness, color, and fracture characteristics. In addition, color photographs will be taken of the core.

The corehole shall be advanced approximately 20 feet below the bottom of the 4-inch stainless steel casing.

9. The corehole will be flushed thoroughly with potable water to removing any remaining cuttings at completion of the final core run.
10. The protective casing and concrete pad will be installed to complete the installation.

Saprolite Wells

1. Advance the borehole with 6-inch I.D. hollow stem augers to approximately 11 feet below the static water table.

2. The lengths of all screen and riser casing sections, bottom plugs, etc. will be measured and recorded.
3. The desired sections of 2-inch well screen and riser pipe will be assembled and lowered to the bottom of the borehole through the augers. Centralizers will be at the bottom of the well screen and at 30 foot intervals.
4. Washed silica filter sand will be poured via tremie pipe through the augers while the augers are pulled back incrementally to construct a continuous filter pack within the borehole annulus which will extend from approximately one (1) foot below the well screen to a minimum of two (2) feet above the slotted section. The depth to the sand pack will be frequently measured through the augers using a properly decontaminated stainless steel weight attached to a fiberglass measuring tape to maintain the sand inside the augers as the filter pack is constructed.
5. A 2-foot-thick layer of very fine sand will be installed immediately above the filter pack of each well prior to installation of the bentonite seal. This very fine sand layer will consist of Foster-Dixiana BX-30 or equivalent. The low permeability of the fine sand will act as an additional safeguard to ensure that grout contamination of the filter pack adjacent to the well screen will not occur.
6. A 2-foot-thick bentonite seal will be constructed by pouring bentonite pellets through a tremie pipe into the annular space within the augers in the manner described above. Potable water will be added to the borehole at ten minute intervals to aid in the hydration of the bentonite seal. The bentonite seal will be allowed to hydrate for at least 30 minutes prior to placement of grout.
7. Tremie grout the remaining annular space from the bottom up with neat cement grout as described for bedrock well installation.
8. Remove the augers from the ground and top off the grout.

9. After allowing the grout to set approximately 16 hours, install the protective casing and concrete pad to complete the installation.

Final well construction details will be typed on the form included as Figure 5.8. Final bedrock core descriptions will be presented on the form included as Figure 5.9. Test boring logs used for final presentation of standard test boring data are presented in Figure 5.11 (Section 5.7.4).

5.6.5 Well Development

Well development will be conducted within two weeks after each well has been constructed, but no sooner than 48 hours after grouting is completed. Well development will be accomplished by a combination of methods which shall include manual pumping and surging with a PVC hand pump or pumping with a submersible PVC and stainless steel pump. As the wells are developed, ground water temperature, pH, and specific conductance will be monitored as indicator parameters. Well development will continue until indicator parameters are stable ($< 10\%$ change between four consecutive measurements) and the water is free of suspended sediments.

5.6.6 Equipment Decontamination

All equipment shall be decontaminated in accordance with procedures described in Section 5.1.7.

5.6.7 Disposal of Excess Cuttings and Drilling Fluids

Drill cuttings, fluids used in drilling, and water purged from wells during development and sampling shall be disposed of on-site. Cuttings from boreholes shall be spread on the ground in the immediate vicinity of the respective drilling sites. Drilling fluids and water purged from wells shall be allowed to percolate into the ground in shallow depressions or holes dug to prevent runoff in the immediate vicinity of each drilling site. These areas shall be filled with the soil removed to create the depression/hole after completion of drilling and sampling activities.

FIGURE 5.8

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GROUNDWATER MONITORING INSTALLATION DETAIL

PROJECT: _____		JOB NO. _____	
LOCATION: _____		INSTALLATION NO. _____	
CLIENT: _____		TYPE OF INSTALLATION _____	
CONTRACTOR: _____		BORING NO. _____	
DRILLER: _____ CERTIFICATION NO: _____		LOCATION _____	
CRSS FIELD REPRESENTATIVE: _____		INSTALLATION DATE _____	
P.E.: _____			

SURVEY DATUM _____		TOP OF PROTECTIVE CASING (CAP OPEN) EL. _____ STICKUP _____	
GROUND SURFACE ELEVATION: _____		TOP OF WELL CASING OR RISER PIPE EL. _____ STICKUP _____	
SUMMARIZE SOIL CONDITIONS, BACKFILL AND SEALS (NOT TO SCALE)			TYPE OF SURFACE SEAL _____
			THICKNESS OF SURFACE SEAL _____
			TYPE OF PROTECTIVE CASING _____
			INSIDE DIAMETER _____
			TOTAL LENGTH _____
			BOTTOM OF PROTECTIVE CASING EL. _____ DEPTH _____
			TYPE OF WELL CASING OR RISER PIPE _____
			INSIDE DIAMETER _____
			APPROXIMATE DIAMETER OF BOREHOLE _____
			TOP OF WELLPOINT EL. _____ DEPTH _____
		TYPE OF WELLPOINT _____	
		SCREEN GAUGE OR SIZE OF OPENINGS _____	
		INSIDE DIAMETER _____	
		TYPE OF BACKFILL AROUND POINT _____	
		BOTTOM OF WELL POINT EL. _____ DEPTH _____	
		BOTTOM OF BOREHOLE EL. _____ DEPTH _____	

• FIGURES ABOVE REFER TO DEPTH IN FEET	• ALL DEPTHS ARE REFERENCED TO GROUND SURFACE	
--	---	--

_____ LENGTH OF RISER PIPE	+	_____ LENGTH OF POINT	=	_____ TOTAL
-------------------------------	---	--------------------------	---	----------------

BENTONITE SEALS

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BORING NO. _____

PROJECT: _____
CLIENT: _____
CONTRACTOR: _____
EQUIPMENT USED: _____

JOB NO: _____
PAGE NO: _____
LOCATION: _____
ELEVATION: _____
DATE START: _____
DATE FINISH: _____
DRILLER: _____
PREPARED BY: _____

[illegible]

Ground water monitoring well pair MW-2 will be placed within the southeast boundary of the suspected disposal area. This section of the suspected disposal area is outside of former lagoons and drum storage areas. The NUS geophysical survey indicates that the location for MW-2 is not within an anomalous zone. Nonetheless, an OVA will be used to monitor cuttings from the drilling as part of site health and safety precautions. Cuttings that are significantly above background readings will be containerized with ultimate disposal dependent on results of the MW-2 analyses.

5.7 SOIL BORINGS

5.7.1 Objectives and Schedule

Approximately 12 soil borings will be drilled during Phase IB in suspected disposal and storage areas to further investigate the vertical and horizontal extent of contaminant sources. The soil borings will also supplement the hydrogeologic characterization of the site.

5.7.2 Sampling Locations and Frequency

Six (6) borings will be drilled through suspected former lagoon areas. Five additional borings will be placed in the most apparently contaminated former drum storage areas as indicated by the soil gas survey conducted in Phase IA. The final boring will be drilled in an appropriate background location where samples will be collected for determining background levels of metals and pesticides. All soil boring locations will be selected at the completion of Phase IA based on the results of the soil gas survey, analyses of soil samples collected from test pits and existing evidence of former lagoon and drum storage area locations.

Each boring will be advanced to a depth of 25 feet. Soil samples will be collected at five foot intervals from each boring as described in Section 5.6.4.

5.7.3 Task Team and Responsibilities

- On-site Coordinator/Geologist - Field/office liaison
- Confirmation of boring locations
 - Log preparation
 - Overall technical oversight
 - Subcontractor coordination
- Technician
- Health and safety screening
 - Sample packaging and shipment
 - Assistance with record keeping

5.7.4 Equipment and Procedures

Equipment required for this task includes:

- o Drill rig and equipment
- o Stainless steel split spoon samplers
- o Decontamination equipment and supplies
- o Field logbook
- o OVA or HNu
- o Level C health and safety equipment
- o Sample containers
- o Stainless steel utensils
- o Engineers rule

The soil borings will be drilled with hollow stem augers. A tri-cone roller bit or approved plug shall be maintained at the bottom of the augers as they are advanced to prevent cuttings from entering. Split spoon soil samples will be collected at five foot intervals by driving a two-foot-long stainless steel split spoon assembly in accordance with ASTM D-1586-67.

Each split spoon sample collected for chemical analyses will be taken according to the following procedure:

1. Decontaminate sampler as specified in Section 5.1.7.

2. Drive sampler 24 inches with a 140-pound hammer falling 30 inches.
3. Sample aliquots for chemical analyses will be immediately removed from the split spoon sampler using a decontaminated stainless steel spatula, scoop or teaspoon and placed in the appropriate pre-labeled containers provided by the analytical laboratory. Aliquots for volatile organic analyses shall be collected first.
4. Store all sample aliquots for chemical analyses at 4°C.

A portion of each split spoon sample will also be collected for field screening with an organic vapor analyzer. The samples collected for organic vapor screening will be placed in 8 ounce jars so that approximately 2-1/2 inches of headspace remains. The top of the jar will be immediately covered with aluminum foil and the jar lid will be tightly closed to seal the jar. The jars will then be shaken thoroughly and stored in a location protected from direct sunlight or extremely high or low temperatures. The soil samples will be allowed to sit for at least one-half hour prior to headspace screening. Headspace screening will be performed by penetrating the aluminum foil jar cover with the sampling probe of the organic vapor analyzer to extract the gas for analysis. Clean soil sample jars (every tenth jar) will be sealed empty and screened to confirm jar cleanliness. Each jar will be labeled to identify the boring number, sample number, depth of sample and the time each sample was obtained. The results of organic vapor screening will be recorded on a log included as Figure 5.10, including the ambient air temperature at the time screening was conducted, the time each sample was screened, and the background reading on the organic vapor analyzer immediately prior to screening.

Within the suspected lagoon areas, or other potential waste disposal areas, soil boring samples collected from depths of 10, 15 and 25 feet will be sent to the laboratory for analysis of indicator parameters. Samples from above 10 feet will not be analyzed from these borings which will be drilled in areas where samples obtained from test pits will provide near surface characterization. If laboratory analyses of samples obtained from 10 and 15

FIGURE 5.10



PAGE ____ of ____

HEADSPACE ANALYSIS							JOB NUMBER _____
PROJECT _____							DATE SAMPLED _____
CLIENT _____							DATE ANALYZED _____
LOCATION _____							ANALYST _____
INSTRUMENT USED _____							
EXPLORATION NUMBER	SAMPLE NUMBER	DEPTH (FT)	SAMPLE TYPE	SAMPLE READING (PPM)*	BACKGROUND READING (PPM)*	AMBIENT AIR TEMP.	REMARKS**

* PPM REPRESENTS CONCENTRATION OF DETECTABLE VOLATILE AND GASEOUS COMPOUNDS IN PARTS PER MILLION OF AIR.
 ** INDICATE TIME ELAPSED FROM SAMPLING OR REMOVING SAMPLES FROM COOLER.

feet show no contamination, the sample at 25 feet will be discarded at the laboratory. Otherwise, all three samples will be subjected to individual laboratory analyses. All samples will also be subjected to field screening using an organic vapor analyzer as described previously. Results of the field screening will be recorded for correlation with laboratory analytical results.

Soil samples outside of waste disposal or lagoon sites will be collected at 5, 15, and 25 feet for the analysis of indicator parameters determined in Phase IA. If laboratory analyses of samples obtained from 5 and 15 feet show no contamination, the sample at 25 feet will be discarded at the laboratory. Otherwise, all three samples will be analyzed.

All soil samples will be identified in the field by a geologist using visual/manual techniques described in ASTM D-2487 and D-2488. The soils will be classified in accordance with the Unified Soils Classification System and final log of each boring will be typed on the SEC Test Boring Report included as Figure 5.11. The results of organic vapor screening will also be included on the test boring logs.

Physical soils analyses will be conducted on selected soil samples obtained from the test borings to confirm soil classifications made in the field and to provide data for the estimation of hydraulic conductivities. The type, procedures and an estimate of the number of tests which will be performed are summarized below:

<u>Test</u>	<u>ASTM Method</u>	<u>Estimated Quantity</u>
Natural Moisture Content	D-2216	24
Sieve Analysis	D-422	12
Atterberg Limits	D-4318	6

5.7.5 Equipment Decontamination

Equipment will be decontaminated in accordance with the procedures described in Section 5.1.7.

5.7.6 Borehole Abandonment and Disposal of Excess Cuttings

All boreholes will be abandoned by tremie grouting with cement/bentonite grout. Cuttings from boreholes shall be spread thinly over the ground surface in the immediate vicinity of the respective drilling sites.

5.8 GROUND WATER SAMPLING

5.8.1 Objectives and Schedule/Sampling Locations and Frequency

One set of ground water samples will be collected from surficial and bedrock monitoring wells at MW-2 and MW-4 during Phase IA. These four (4) sets of samples will be analyzed for the complete list of TCL parameter to assist in finalizing the site specific list of indicator parameters to be utilized in Phase IB sampling efforts. One set of samples will be collected from the wells installed at MW-1 and MW-3 along with the wells at MW-2 and MW-4 during Phase IB. The eight (8) sets of samples collected during Phase IB will be analyzed for the indicator parameter list. Ground water samples will be obtained in accordance with EPA Region IV protocols. The ground water analyses will be evaluated to assess potential impacts to ground water at the site.

5.8.2 Sampling Locations and Analytical Requirements

Monitoring well locations are shown on Figure 5.5 (section 5.6.2).

Analytical requirements are discussed above and in section 5.1.3.

5.8.3 Task Team and Responsibilities

On-site Coordinator/Sampling Specialist	- Field/office liaison
	- Overall technical oversight
Technician	- Health and safety screening
	- General support

5.8.4 Equipment and Procedures

Equipment required for this test includes:

- o Field logbook
- o ph meter/calibration standards
- o Thermometer
- o Conductivity meter
- o Water level indicator
- o Purge pump
- o Generator
- o Closed top bailers - teflon
- o Rope
- o Fiberglass measuring tape and stainless steel weight
- o Sample containers and labels
- o Sample packaging and shipping equipment
- o Sample document control and shipping forms
- o Decontamination solutions and equipment
- o Organic vapor analyzer
- o Level C health and safety equipment

The SEC Field Data Information Log (Figure 5.12) will be used to record all measurements made during well purging and sampling. This form was designed to be used as a checklist and as documentation for all ground water sampling activities for an individual well. Information to be recorded on this form will include:

- | | |
|----------------------|------------------------------|
| o data | o field personnel |
| o site/facility name | o well identification |
| o weather conditions | o total well depth |
| o ground water depth | o well diameter |
| o casing material | o well volume calculation |
| o evacuation method | o well integrity |
| o field pH | o field specific conductance |
| o field Eh | o water temperature |

Field Data Information Log for Ground-Water Sampling

Sirrinc Environmental Consultants
P.O. Box 5229
Greenville, SC 29606

<p>Date (yr/mo/day) _____</p> <p>Field Personnel _____</p> <p>Site Name _____</p> <p>SEC Job # _____</p> <p>Well ID # _____</p> <p>____ Upgradient ____ Downgradient</p> <p>Weather Conditions _____</p> <p>Air Temperature _____ °C</p> <p>Total Well Depth (TWD) = _____ 1/100 ft</p> <p>Depth to Ground Water (DGW) = _____ 1/100 ft</p> <p>Length of Water Column (LWC) = TWD - DGW = _____ 1/100 ft</p> <p>1 Casing Volume (OCV) = LWC x _____ = _____ gal</p> <p>5 Casing Volumes = _____ gal = Standard Evacuation Volume</p> <p>Method of Well Evacuation _____</p> <p>Method of Sample Collection _____</p> <p>Total Volume of Water Removed _____ gal</p>	<p>Casing Diameter _____ inches</p> <p>Casing Material _____</p> <p>Measuring Point Elevation _____ 1/100 ft</p> <p>Height of Riser (above land surface) _____ 1/100 ft</p> <p>Land Surface Elevation _____ 1/100 ft</p> <p>Screened Interval _____ 1/100 ft</p> <p>Dedicated Pump or Bailer YES ____ NO ____ Type _____</p> <p>Steel Guard Pipe Around Casing YES ____ NO ____</p> <p>Locking Cap YES ____ NO ____</p> <p>Protective Post/Abutment YES ____ NO ____</p> <p>Well Integrity Satisfactory YES ____ NO ____</p> <p>Well Yield LOW ____ MODERATE ____ HIGH ____</p> <p>Remarks _____</p> <p>_____</p> <p>_____</p> <p>_____</p>
--	---

FIELD ANALYSES						
VOLUME PURGED (gallons)						
TIME (military)						
pH (S.U.)						
Eh (mV)						
Sp. Cond. (µmhos/cm)						
Water Temp. (°C)						
TURBIDITY (subjective) *						
* (1) Clear (2) Slight (3) Moderate (4) High						
COMMENTS/OBSERVATIONS: _____						

FIGURE 5.12

Completed Field Data Information Logs will be included for each well in the RI Report for this investigation. Sampling activities will also be documented in the field logbook.

Prior to the initiating of any activities at each well site, all sampling personnel will don new, laboratory grade gloves. These gloves will be replaced as necessary during well evacuation and sampling, and always changed between wells.

When the well is opened for sampling, any odors detected will be noted and the presence of organic vapors will be screened using an organic vapor analyzer.

5.8.4.1 Well Evacuation

Each well will be purged prior to sample collection to remove any stagnant water from the well, thereby ensuring that the samples collected are representative of the water quality surrounding each well. Prior to well evacuation or sample collection, the ground water depth is determined using an electronic water level meter as described in Section 5.10. Following each use, the instrument is cleaned according to the field cleaning procedure described in Section 5.1.7.

For wells that recover quickly, three to five volumes of water are removed. Specific conductance, pH, and water temperature will be measured periodically during well evacuation. Wells that can be evacuated to dryness with less than five well volumes being removed will be sampled as soon as the well has recovered enough to yield sufficient volume for a sample.

Well purging will be accomplished using teflon bailers or submersible pumps. Purging techniques will be in accordance with procedures described in section 4.7.5.3 of the EPA Region IV SOPQAM (April, 1986). The volume of water to be evacuated is calculated using the following equation:

$$V = r^2h$$

where:

= 3.14159

r = radius of well casing

h = height of water column in well (Total well depth - depth to ground water prior to purging.)

V = volume of water in well

Minimum Purge Volume = $V \times 5$

5.8.4.2 Sample Collection

1. After the well has been purged, collect the sample with the bailer. The sample containers will be filled directly from the bailer.
2. Measure the record in log book and pH, temperature, and specific conductance of the sample. These measurements may be taken from a sample collected in an additional container. All instrument calibrations will also be recorded.
3. Add chemical preservatives to sample bottles, if applicable.
4. Using black vinyl tape, secure caps on bottles to prevent leakage. (Tape will not be used on samples intended for volatile organic analysis.)
5. Place VOC samples in plastic bags and seal.
6. Complete documentation for all samples.
7. Pack samples in coolers with ice pack samples for shipment.
8. Complete appropriate sections of chain-of-custody.
9. Ship samples to analytical laboratories within 24 hrs.
10. Advise subcontracted laboratory of sample shipment.

5.8.5 Equipment Decontamination

Equipment shall be decontaminated in accordance with procedures described in Section 5.1.7. Purge pump tubing which has been submerged during well evacuation will be discarded between well locations.

5.8.6 Disposal of Water Purged From Wells

Water purged from monitoring wells prior to sampling shall be handled as described in Section 5.6.7.

5.9 SURFACE WATER AND SEDIMENT SAMPLING

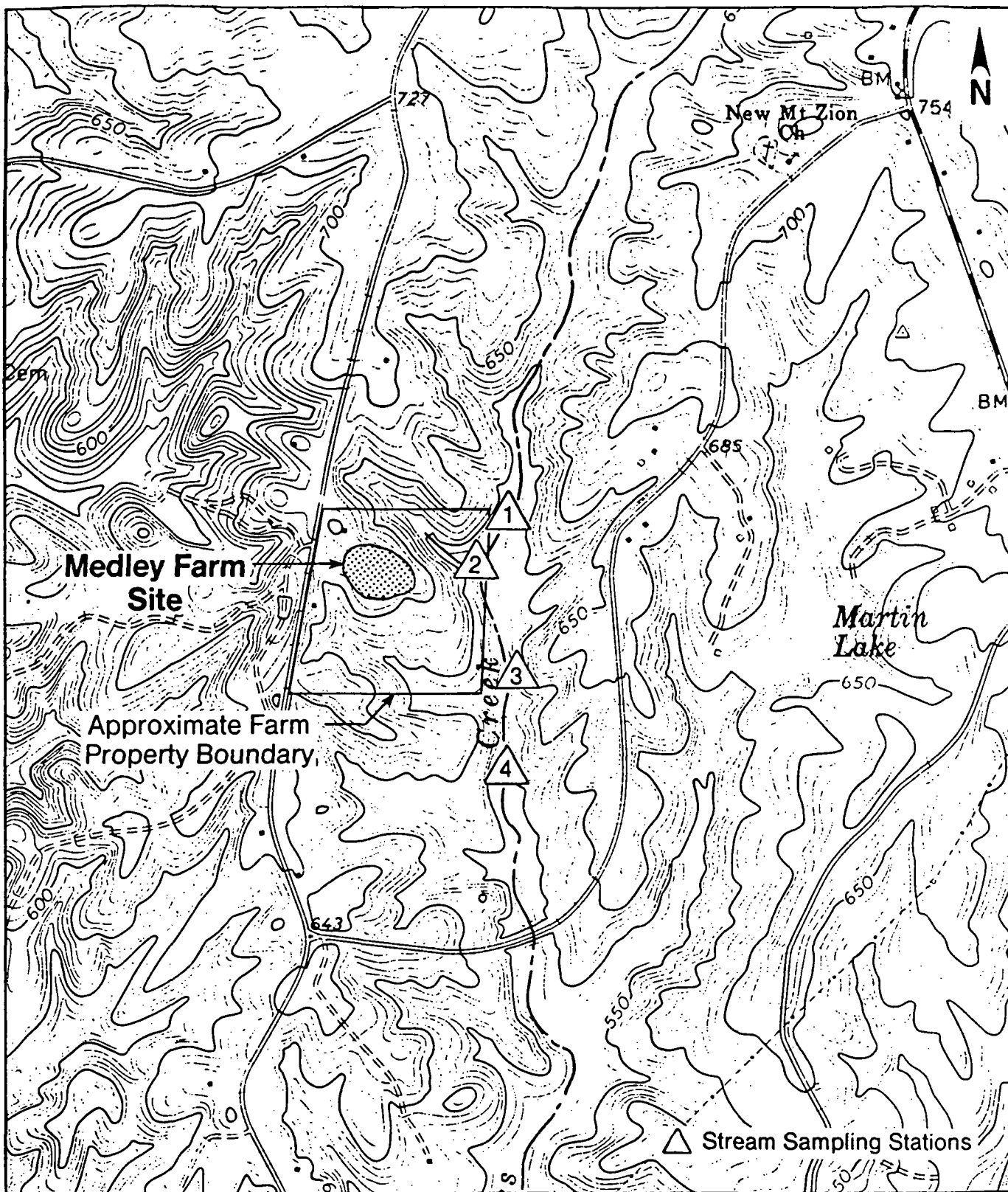
5.9.1 Objectives and Schedule

Surface water and sediment samples will be collected to determine the presence or absence of contaminants in these media and to compare the quality of surface water and bottom sediments entering and leaving the site. All surface water and sediment sampling will be conducted during Phase IB of the RI.

5.9.2 Sampling Locations and Analytical Requirements

Surface water and sediment samples will be obtained from four (4) locations. Approximate sampling locations are shown on Figure 5.13. The rationale for the selection of these locations is presented briefly below:

- o RW-1/SS-1; this location is upgradient from the site. These samples will define background surface water and stream sediment conditions in Jones Creek.
- o RW-2/SS-2; this location was selected to screen for any potential migration of contaminants in this tributary to Jones Creek.
- o RW-3/SS-3; this location appears to be immediately downgradient from the Medley Site. These samples will screen for potential



USGS Pacolet Mills Quadrangle (1969)

Scale 1:14,100

Figure 5.13

Proposed Locations of Stream Sampling Stations

Medley Farm Site Gaffney, South Carolina



contaminant migration directly into Jones creek through base flow recharge or direct surface runoff.

- o RW-4/SS-4; this location is further down stream along Jones Creek, also downgradient from the site. These samples are intended to investigate whether contamination may be migrating from the site along this drainage course.

One sediment and one surface water sample will be obtained from each sampling location.

All surface water and sediment samples will be analyzed for the list of site specific indicator parameters developed at the completion of Phase IA.

5.9.3 Task Team and Responsibilities

On-site Coordinator/Geologist

or Sampling Specialist

- Field/office liaison
- Confirmation of sampling locations
- Overall technical oversight

Technician

- Support

5.9.4 Equipment and Procedures

Equipment required for this task includes:

- o Field logbook
- o Camera
- o pH meter
- o Thermometer
- o Conductivity meter
- o Engineers rule
- o Stainless steel spoons or spatulas
- o Hand auger with stainless steel bucket
- o Stainless steel trowel or scoop
- o Pyrex glass or stainless steel mixing bowls

- o Sample containers and labels
- o Coolers with ice packs
- o Sample document control forms
- o Decontamination solutions and equipment
- o Level D health and safety equipment

All surface water samples will be collected prior to sediment samples to avoid the influx of sediment into the surface water samples.

5.9.4.1 Surface Water Sample Collection

The following procedures will be followed for collecting surface water samples:

1. Sketch sampling location in field logbook. Photograph location of sample collection.
2. Prepare sample bottles and labels and don uncontaminated gloves.
3. Collect water sample by lowering sample bottle(s) into water facing upstream allowing water to enter and fill container completely.
4. Add chemical preservatives, if applicable, and secure caps. Decontaminate sample bottle(s) and affix labels.
5. Place sample containers in coolers, packed with ice.
6. Measure and record physical characteristics of the water body including: depth of water at sampling location, odor, color, turbidity, water temperature, pH, specific conductance and vegetation.
7. Complete appropriate portions of chain of custody.

5.9.4.2 Sediment Sample Collection

The following procedures will be followed for collecting stream sediment samples:

1. Sketch sampling location in field logbook.
2. Depending on the character and accessibility of the sediments, a stainless steel trowel or hand auger may be used to collect the samples.
3. If it is necessary to wade into the water, the team member collecting the sample will go downstream of the sample collection point to avoid disturbing sediments. Sampling will begin at the furthest downstream sampling point and proceed upstream to avoid disturbing bottom sediment at the sampling location.
4. Prepare sample containers and labels.
5. With a stainless steel or glass mixing bowl and sampling equipment ready, don uncontaminated gloves.
6. Collect sediment samples while facing upstream and deposit the sediments into the mixing bowl.
7. Homogenize the sample thoroughly with a stainless steel spoon or spatula as described in Section 4.6.3.3.4 of the EPA Region IV SOPQAM (April 1986).
8. Transfer the sample aliquots to the appropriate pre-labeled sample containers and secure caps.
9. Place sample containers in coolers packed with ice.
10. Measure and document in the field logbook physical characteristics of the sampling point including: depth of water at sampling point, soil

description of sediment sampled, stream bed characteristics at sampling point, etc.

11. Complete appropriate portions of chain of custody.

Representative sampling points for surface water and sediment samples will be selected in accordance with the criteria described in Section 4.6.2.1 of the EPA Region IV SOPQAM (April 1986). Surface water sampling points where natural mixing occurs such as immediately below natural channel constrictions or riffles will be selected. Sediment samples will be collected from depositional areas such as inside river bends.

5.9.5 Equipment Decontamination

All sampling equipment will be decontaminated in accordance with the procedures described in Section 5.1.7.

5.10 GROUND WATER LEVEL MEASUREMENT

5.10.1 Objectives and Schedule

Water level measurements will be taken from all monitoring wells installed at the site during the Remedial Investigation and from the existing SCDHEC well (MDZA). Water level measurements will be made on a bi-monthly basis or more frequently during the RI to monitor water level fluctuations. Water level measurements will be taken from all monitoring wells at the site on the same day at least two times during the RI to provide two complete sets of comparable measurements. Surveyed elevations will be established at each well to determine water level elevations. These water level measurements will be used to calculate hydraulic gradients and determine directions of ground water flow at the site.

5.10.2 Equipment and Procedures

All water level measurements will be made using an electronic water level meter. The water levels will be measured by slowly lowering the instrument

probe into the well. When the probe reaches the water surface, the circuit is completed and a buzzer is activated. The distance from the top of the well casing to the water level is then measured and recorded. The water level indicator cable is calibrated in increments of 0.05 feet. Water levels will be estimated to nearest 0.01 feet.

All water level measurements will be recorded in the field logbook including: date and time of measurement, description of measuring point and the name of the individual making the measurement. When the well cap is removed, an organic vapor analyzer will be used to screen the air space immediately above the well casing. The level of vapors detected and any odors noted will also be recorded.

A history of all ground water level measurements taken during the RI will be maintained for each well on a Ground Water Level Monitoring Report (Figure 5.14). Complete sets of water level measurements taken on the same day will be recorded on the Water Level Summary Report (Figure 5.15).

5.10.3 Equipment Decontamination

All equipment will be decontaminated between wells in accordance with the procedures described in Section 5.1.7.

5.11 HYDRAULIC TESTING

5.11.1 Objectives and Schedule

In situ hydraulic testing will be used to evaluate the hydraulic characteristics of the saprolite and bedrock aquifers beneath the site. Slug tests will be performed during Phase IA of the RI to determine representative hydraulic conductivity values in the saprolite. Water pressure tests will also be conducted during Phase IA in the open-hole sections of bedrock wells to measure rock mass permeabilities at those locations.



SIRRINE
ENVIRONMENTAL
CONSULTANTS

GROUND-WATER LEVEL MONITORING REPORT

[illegible]

* INDICATE ELAPSED TIME AFTER INSTALLATION, DEVELOPMENT OR PURGING, RECENT WEATHER, ETC.

PAGE ____ of ____

[illegible]

During Phase IB, a pump test may be run in one of the bedrock wells to evaluate the interconnectivity of the saprolite and bedrock and to develop more information on the hydrogeologic characteristics of the subsurface environment. The decision to conduct a pump test will be based on whether the groundwater contaminant levels found in Phase IA indicate the potential need for aquifer remediation. The test information will be used to evaluate the feasibility of ground water extraction as a method of remediation at the site, if required.

5.11.2 Hydraulic Testing Locations

Slug tests will be conducted in each of the saprolite water table wells installed during the RI. Water pressure tests will be conducted in all monitoring wells installed in the bedrock where coring is performed.

Figure or Table 5.14

The location and necessity of a pump test will be evaluated at the completion of Phase IA of the RI.

5.11.3 Task Team and Responsibilities

On-site Coordinator/Hydrogeologist - Field/office liaison
- Personnel coordination
- Overall technical oversight

Technicians - Support personnel

5.11.4 Equipment and Procedures

5.11.4.1 Slug Test Procedures

Equipment required for this task includes:

- o Field logbook
- o Data logger and water level transducers
- o Electronic water level tape

- o Displacement slug
- o Decontamination solution and equipment
- o Level D or C health and safety equipment (based on previous well site screening data)

Slug tests will be performed and evaluated in accordance with procedures described by Hvorslev (U.S. Army Bulletin #36). Rising head permeability tests rather than falling head tests will be performed in all saprolite/water table wells since an induced rise in water level would result in water running out into the unsaturated portion of the gravel pack resulting in inaccurate hydraulic conductivity estimates. A conservative range of permeability values can be obtained by subjecting each test to three methods of analysis. Methods described by Hvorslev (1951), Bower and Rice (1976) and Nguyen and Pinder (1984) will be used.

Procedures to be followed for performing slug tests outlined below:

1. Measure and record the depth to water with the electronic water level tape.
2. Install water level transducer in monitor well.
3. Record static water level. Check that it agrees with initial measurement.
4. Introduce slug into well.
5. Allow water level to stabilize.
6. Activate data logger and instantaneously remove slug.
7. Allow water level to stabilize.
8. Record data.

5.11.4.2 Water Pressure Test Procedures

Equipment required for this task includes:

- o Field logbook
- o Water pump
- o Water meter (measures flow to 0.1 gallons; calibrated)
- o Water pressure gauges (PSI; calibrated)
- o Pneumatic packer system
- o Surge tank (optional, depending on pump type)
- o Drill rig
- o Miscellaneous pipe, fittings and valves
- o Nitrogen tank with pressure regulator and two gauges
- o Air hose (reinforced)
- o Time piece
- o Engineers rule

Water pressure tests will be conducted using both double and single pneumatic packers in accordance with the general procedures described in the U.S. Bureau of Reclamations Ground Water Manual, 1977. Test zones will be determined by examining the retrieved bedrock cores. Each test zone will typically be tested at three approximately equal pressure steps to provide data for assessing the hydraulics of flow in the bedrock fractures. Maximum test pressures will be based on the available hydraulic head as determined from water level measurements made in wells constructed at the site.

5.11.4.3 Pump Tests

Equipment required for this task includes:

- o Field logbook
- o Data logger and water level transducers
- o Electronic water level tapes
- o Stainless steel and teflon submersible pumps
- o Water flow meter(s)
- o Miscellaneous ppe, fittings, valves, hoses

- o Generator
- o Barometer

A pre-test will be run to determine optimum flow rate, to adjust flow controls and test all equipment. After water levels have stabilized from the pretest, at least 12 hours of water level data will be collected immediately prior to conducting the test. The pump test will be run for a minimum of 24 hours at a constant pumping rate. Recovery will be monitored for a minimum of 12 hours after pumping has ceased. Ground water, pH, specific conductivity, and discharge rate will be monitored throughout the test. The pump tests will be conducted in accordance with procedures described in Groundwater and Wells (Johnson Division, 1986) and Groundwater Pumping Tests (Walton, 1987).

The pump test location will be selected after chemical analyses of ground water samples have been completed. The pump test location will be selected to minimize potential impact to existing ground water conditions. If analyses indicate that the ground water contains hazardous constituents above action levels at the test location, water from the pump test will be discharged according to state requirements or containerized for proper disposal.

Appropriate data analysis methodology will be selected based on the characteristics of the drawdown curve. Porous media analyses, based on Theis, 1935, will be performed if appropriate. If porous media analyses are not appropriate it is anticipated that a single porosity randomly distributed block and fissure model will be used (Streltsova-Adams, 1978).

5.11.5 Equipment Decontamination

Equipment will be decontaminated in accordance with procedures described in Section 5.1.7.

5.12 STREAM GAUGING AND SURFACE HYDROLOGY

5.12.1 Objectives and Schedule

The base flow contribution from the site to Jones Creek will be evaluated using surface water level and flow measurements obtained from the stream gauging stations and ground water level measurements which will be obtained from all monitoring wells installed during this investigation. Measurements will be taken from stream gauging stations and monitoring wells during the same site visits to at least twice during the RI (same days) to enable comparison of data. Water levels observed in monitoring wells installed in close proximity to the creek (MW-3 and MW-4) will be compared with each other (between different aquifer zones) and with nearby surface water elevations to determine whether hydraulic gradients are present which would induce ground water flow to Jones Creek. Precipitation records will also be obtained through the National Climatic Center in Asheville, North Carolina and a hydrologic budget of the site will be calculated.

5.12.2 Gauging Station Locations

Stream gauging stations will be set up and monitored at two locations on Jones Creek located upgradient and downgradient from the site to estimate surface runoff and ground water contributions from the site. Gauging locations will be based on accessibility and uniformity of stream cross sections.

5.12.3 Task Team and Responsibilities

On-site Coordinator/Hydrogeologist - Field/office liaison
- Overall technical oversight

Technician - Support

5.12.4 Equipment and Procedures

Equipment required for this task includes:

- o Field logbook
- o Camera
- o Current meter
- o Engineer's rule
- o 100 ft. surveyors tape and weight
- o Level D health and safety equipment
- o Rubber boots

Stream gauging shall be conducted in accordance with procedures described in Section 10.1.5.2 of "A Compendium of Superfund Field Operations Methods" (EPA/540/P-87/001) using methods described below. A permanent vertical staff gauge will be installed at each gauging station to record the streams relative stage at the times measurements are taken. Each staff gauge will be graduated in tenths of feet with an arbitrary zero point set below the elevation of the stream bed to allow for potential bed erosion. The following information will be recorded each time readings are taken:

- o Project
- o Site
- o Date
- o Time at start of measurements
- o Stream stage at start of measurements
- o Approximate wind direction and speed
- o General stream condition (e.g., turbid, clear, floating debris, water temperature, type of streambed material, etc.)
- o Other factors having a bearing on discharge measurements
- o Locations of measurement points
- o Total width of stream to be measured
- o Type of current meter and conversion factor, if applicable
- o Name of investigator taking the above reading

The following procedures will be followed when taking stream flow measurements:

- o Assemble current meter and test for proper operation in accordance with the manufacturer's instructions.

- o Partition stream into sections using surveyors tape, visually observing the velocity and general flow of the stream. Enough stations will be established to prevent more than 10 percent of the total discharge from passing through any individual section.
- o Photograph the set up.
- o Record stream stage as indicated by the staff gauges in the field logbook.
- o Measure the water depth at each measurement station and record.
- o Where depths are less than or equal to 2.5 ft., measure the flow velocity at 60 percent of the total depth from the water surface. Where depths are greater than 2.5 ft., obtain flow measurements at 20 percent and 80 percent of the total depth from the water surface.
- o Continue to each successive station as rapidly as possible, following the same procedure.
- o Record the ending time of this series of measurements and the stage, since the stage may have changed during the measurements.

6.0 SAMPLE CUSTODY

Each sample received by the analytical laboratory for processing must be properly documented to ensure complete and accurate analysis for all parameters requested, and most importantly, to support the use of sample data in potential remedial actions concerning a site. The Region IV EPA system of documentation provides the means for tracking each sample from the time of collection through final data reporting. In this POP, a sample is defined as a representative specimen collected from a specific location at an exact point in time for a particular analysis, and is referenced to field samples, duplicates, replicates, splits, spikes, or blanks that are shipped from the field to an analytical laboratory.

6.1 FIELD LOGBOOK ENTRY PROCEDURES

Field logbooks provide a means for documenting all data collecting activities performed at a site. Entries should be as descriptive and detailed as possible, so that a particular situation could be reconstructed without reliance on the collector's memory.

All measurements made and a detailed description of each sample collected are recorded. All logbook entries will be made with indelible ink and legibly written. The language should be factual and objective. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark, initialed, and dated. Entries should be organized into tables to the degree possible.

A bound field logbook shall be maintained by the field sampling manager to provide a daily record of events. At the beginning of each entry, the following shall be recorded:

- o Date
- o Time
- o Meteorological conditions
- o Field personnel present
- o Level of personal protection

- o Signature of the person making the entry

A simple drawing of the site (not to scale) shall be included in the logbook to provide an illustration of all sampling points.

The cover of each logbook used shall contain:

- o Person or organization to whom the book is assigned
- o Book number
- o Project name, number
- o Start date
- o End date

Entries in the logbook shall include at a minimum the following for each sample date:

- o Site identification
- o Location of sampling points
- o Description of sampling points
- o References to photographs of the site and brief sketch of sampling points
- o Sample identification number
- o Number of samples taken
- o Time of sample collection
- o Reference to sample location map
- o Number of QA samples taken (e.g., duplicates)
- o Collectors' names
- o Field observations
- o Sample distribution (e.g., QA laboratory, agency split)
- o All field measurements made (e.g., pH, temperature, specific conductance)

6.2 PHOTOGRAPHS

Photographs shall be taken to document unusual sampling locations or conditions and all other pertinent information such as site topography and

current site conditions. The name of the photographer, date, time, site location and site description shall be entered sequentially in the field logbook as photos are taken. The following table summarizes pertinent notes in regard to accurate photography:

- o 35 mm color slides shall be used unless specified otherwise
- o Photos shall show surrounding area and reference objects for scale
- o Picture number, roll number (if more than one roll of film is used), and description of picture shall be logged in the field notebook

6.3 SAMPLE HANDLING

Personnel collecting soil, ground water, and air samples shall take the following precautions to minimize sample contamination or cross-contamination between samples:

- o At a minimum, latex surgical gloves will be used while taking all samples, disposed of after equipment has been decontaminated, and a clean pair used for the next sample
- o Sampling personnel shall not touch the inside of the sampling container
- o Sampling personnel shall not walk over any areas where samples will be taken

Immediately following the collection of the sample, the container shall be sealed and the sample shall be labeled and entered in the field sampling logbook, as described in Section 6.1. At this time, the chain of custody form record shall be completed to note the acquisition of the sample (see Section 6.4).

The sample shall then be placed in the shipping container and preserved according to CLP Protocol. Specific sample handling requirements for each media of interest are given in Section 5.

6.3.1 Sample Container Preparation

The preparation procedures are designed to provide maximum confidence that containers used to ensure sample integrity from the time of collection to the time of analysis do not introduce foreign substances (contamination) to such samples. Because of the possibility of contamination existing in even new containers, all containers used in the sampling event shall be unused manufacturer prepared sample containers or certified clean from the manufacturer or Contractor laboratory.

6.3.2 Sample Identification and Labeling

Proper sample identification is an essential part of any field sampling project. Because of its importance to accurate data acquisition, documentation and labeling of samples in the field is necessary. Each sample shall be identified in the field logbook and on the sample container label. The sample label shall include the following information:

- o Date and time
- o Name of sample collector
- o Project number
- o Project name
- o Sample location (short description)
- o Sample I.D.
- o Matrix
- o Analysis
- o Preservatives
- o Sample type (grab/composite)

An example sample label is shown in Figure 6.1. Any relevant comments regarding odor, color, or other physical characteristics will be recorded in the field log.

FIGURE 6.1
TYPICAL SAMPLE LABEL

SIRRINE ENVIRONMENTAL CONSULTANTS
DATE: _____ TIME: _____
COLLECTED BY: _____
JOB NUMBER: _____
JOB NAME: _____
SAMPLE LOCATION: _____
SAMPLE ID: _____
MATRIX: _____
ANALYSIS: _____
PRESERVATIVES: _____
SAMPLE TYPE: GRAB COMPOSITE

6.3.3 Sample Identification

The sample and matrix type will be identified according to the following designations:

- A - Air sample (if necessary)
- SB - Soil from test boring
- TP - Soil from test pit
- SW - Ground water from monitoring well screened in saprolite
- BW - Ground water from monitoring well screened in fractured bedrock
- SS - Streambed sediment
- RW - Surface water

The sample location will be identified through a number immediately following the letter designation. For example, BW3 indicates a ground water sample from bedrock monitoring well number 3. The sequence of samples from a given location will be indicated by a hyphen followed by a number denoting the sample interval. For example, the sample from the second depth interval collected in soil boring number 2 would be identified as SB2-2. Sampling data will be included on the label of each sample. All field personnel will be briefed on sample identification prior to the start of field activities.

6.4 SAMPLE CHAIN OF CUSTODY

It is imperative that an accurate record of sample collection, transport, analysis, and disposal be maintained and documented. Therefore, chain of custody procedures will be instituted and followed throughout the RI.

Chain of custody procedures include field custody, laboratory custody and evidence files. The National Enforcement Investigation Center (NEIC) of the EPA defines custody of evidence in the following ways:

- o In actual physical possession
- o In view after being in physical possession
- o In a locked repository
- o In a secure, restricted area

It is necessary to establish documentation to trace sample possession from the time of collection until disposal. The following list outlines field custody requirements:

- o As few people as possible shall handle sample(s)
- o Sampler shall be responsible for the care and custody of the samples until they are transferred or dispatched properly

Samples shall be stored by those individuals or facilities designated on the chain of custody form. The following methodologies will be used to ensure proper transfer documentation:

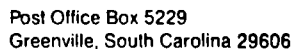
- o Samples shall be accompanied by a chain of custody record at all times
- o Samples shall be packed properly for shipment so that bottles will not dislodge and/or break during shipment
- o Shipped samples shall contain separate custody records (one for field laboratory, one for samples hand delivered to off-site laboratory, and one for samples shipped off-site)
- o Samples shall be shipped via a 24-hour delivery service, when required, to ensure holding times are not exceeded
- o Methodology of shipment, courier name(s), and other pertinent information shall be recorded on chain of custody form, with all measures ensuring special handling procedures as available by the delivery service utilized during shipment of the samples
- o When samples are split with an outside source or government agency, the split shall be noted
- o If either party refuses a split sample, the refusal shall be noted and signed by both parties

- o All records pertaining to the shipment of a sample shall be retained (freight bills, post office receipts, and bills of lading)

Figure 6.2 is the Chain of Custody Form to be used by personnel responsible for ensuring the integrity of samples from the time of collection to shipment to the laboratory. The Contractor laboratory shall not accept samples for analysis without a correctly prepared Chain of Custody Form. The Contractor laboratory shall be responsible for maintaining chain of custody of the sample(s) from time of receipt to disposal. The Contractor laboratory shall use all forms and techniques specified by the EPA-CLP to ensure the integrity of all samples.

The Chain of Custody Form shall be signed by each individual who has the samples in their possession. Preparation of the Chain of Custody Form shall be as follows:

- o The chain of custody record shall be initiated in the field by the person collecting the sample, for every sample. Every sample shall be assigned a unique identification number as described in Section 6.3.3 that is entered on the chain of custody form. Samples can be grouped for shipment using a single form. The chain of custody form allows for 12 samples.
- o The record shall be completed in the field to indicate project, sampling team, etc.
- o If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for "Relinquished By _____," "Received By _____" shall be completed in the field.
- o The person transporting the samples to the laboratory or delivering them for shipment shall sign the record form as "Relinquished by _____."



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FIGURE 6.2

- o If the samples are shipped to the laboratory by commercial carrier, the chain of custody form shall be sealed in a watertight container, placed in the shipping container, and the shipping container sealed prior to being given to the carrier.
- o If the samples are directly transported to the laboratory, the chain of custody shall be kept in the possession of the person delivering the samples.
- o For samples shipped by commercial carrier, the waybill shall serve as an extension of the chain of custody record between the final field custodian and receipt in the laboratory.
- o Upon receipt in the laboratory, the Sample Receiving Supervisor shall open the shipping containers, compare the contents with the chain of custody record, ensure that document control information is accurate and complete, and sign and date the record. Any discrepancies shall be noted on the chain of custody form.
- o If the discrepancies occur, the samples in questions shall be segregated from normal sample storage and the field personnel immediately notified.
- o The chain of custody is completed upon receipt of the samples by the analytical service. The completed Chain of Custody Form will be returned to the field manager.
- o The analytical service shall track, internally, sample integrity utilizing a procedure defined by the Contract Laboratory Program (CLP).

6.5 SAMPLE PACKAGING AND SHIPPING

The transportation of environmental samples from the time they are collected to their arrival at Radian Laboratories in Research Triangle Park, North Carolina is an integral part of the Medley Farm Site RI. The mode of travel

must be such that the sample is not altered physically, chemically or biologically. The travel time to the laboratory must not interfere with the sample holding time. The chain of custody must also be maintained during the transportation process.

The protection of personnel involved in the shipment of samples to contract laboratories is important as well as the maintenance of the integrity of the samples themselves. When sent by common carrier, the packaging, labeling and shipping of hazardous waste and substances is regulated by the U.S. Department of Transportation (DOT) under CFR 49.

Samples obtained at uncontrolled hazardous waste sites are classified as either environmental samples or hazardous samples. Environmental samples are those which contain low levels of contaminants and require implementation of limited precautionary procedures. Samples at the Medley Farm Site are tentatively being considered environmental samples. Hazardous samples are those which could possibly contain dangerous levels of contaminants i.e., 15 percent. Hazardous samples must be packaged and labeled according to procedures specified by the U.S. DOT, or the state DOT, whichever is more stringent.

Samples collected at the site will be immediately placed in the sample cooler. The sealed and labeled container is placed inside a secure ice chest and packed to prevent breakage. Once the cooler is filled with samples, it is latched and securely positioned in a SEC sampling vehicle or other secure storage facility until the completion of the day's sampling activities. The following protocol will be followed for packaging of samples:

- o Only waterproof metal or equivalent strength plastic ice chests and coolers will be used.
- o Following the completion of the sample label and tag, the sample will be carefully placed or poured into the container in the field. The sample tag will then be attached to the container.

- o The labels will be permanently affixed to each container. All labels will be completed with an indelible pen.
- o The volume level will be marked on each bottle with a grease pencil.
- o Strapping tape will be placed around the lid of all sample bottles except for volatile organic samples.
- o Approximately 3 inches of inert cushioning material will be placed in the bottom of the cooler.
- o The bottles will be enclosed in clear plastic bags through which sample tags and labels are visible. All bottles will be placed upright in the cooler in such a way that they do not touch and will not touch during shipment.
- o Additional inert packing material will be placed in the cooler to partially cover the sample bottles. Ice or freeze packs will be placed around, among, and on top of the sample bottles.
- o Each cooler will be filled with additional cushioning materials to prevent movement of samples during shipment.
- o The chain of custody record will be placed in a waterproof plastic bag and taped to the inside lid of the cooler.
- o If the cooler is equipped with a drain plug, it will be taped shut.
- o The lid will be secured with strapping tape at a minimum of two locations. No labels will be covered.
- o The completed shipping label will be attached to the top of the cooler.

- o "This Side Up" labels will be placed on all four sides of the cooler, and "Fragile" labels will be placed on two sides.
- o Numbered and signed custody seals will be placed on the front right and back left of each cooler. These seals will be covered with clear tape.
- o The weight limit of the shipper will be maintained.

As soon as field personnel are ready to transport samples from the field to the laboratory, they will notify the laboratory by telephone of the shipment. If the samples are transported by field personnel, the estimated time of arrival at the laboratory should be given. If the samples are shipped by commercial carrier, the laboratory should be telephoned as soon as the shipping containers are consigned to the shipper. Figure 6.3 contains the information that must be provided to the laboratory. A blank of this form will be completed at the laboratory during the telephone conversation.

The final step in providing information to the laboratory is shown on Figure 6.4. The Request for Analysis form will be completed by the field personnel and included with the chain of custody record. It is imperative that the Request for Analysis form be provided so that analytical requirements are defined and sample holding times are not exceeded. It is anticipated that all samples will be shipped from the site via Federal Express.

SHIPMENT INFORMATION
(Field to Lab by Telephone)

Signature of Releaser: _____

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Post Office Box 5229
Greenville, South Carolina 29608

REQUEST FOR ANALYSIS

(This form must accompany samples-
Do not send under separate cover)

PROJECT NAME _____ DATE SAMPLES SHIPPED _____
PRO. MGR./JOB NO. _____ LAB DESTINATION _____
PROFIT CENTER NO. _____ LAB CONTACT _____
BILL TO _____ REPORT TO _____
P.O. NUMBER _____ TELEPHONE NO. _____

SAMPLE NO.	SAMPLE TYPE	SAMPLE VOLUME	PRESERVATIVE	REQ'D. TESTING PROGRAM	SPECIAL INSTRUCTIONS

TURNAROUND TIME REQUIRED: (Turnaround time must be arranged with lab prior to shipment)

NORMAL _____ RUSH _____ (Subject to rush service charge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if samples are hazardous
materials and/or suspected to contain high levels of chemical compounds.)

FLAMMABLE _____ POISON _____ SKIN IRRITANT _____ TOXIC _____ OTHER _____
(Please specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis.

Lab will charge for packing, shipping and disposal.)

RETURN TO CLIENT _____ DISPOSAL BY LAB _____

FOR LAB USE ONLY

RECEIVED BY: _____ DATE/TIME: _____

7.0 CALIBRATION PROCEDURES AND FREQUENCY

The purpose of this section is to provide the specific maintenance/calibration requirements for all equipment related to the collection of data either in the field or through laboratory analysis of samples.

7.1 LABORATORY EQUIPMENT

All samples will be sent to Radian Corporation laboratory in Research Triangle Park, North Carolina. Radian's laboratory is under the EPA Contract Laboratory Program (CLP). CLP laboratories have an in place program for equipment calibration procedures and frequency. Detailed procedures describing equipment calibration and frequency are given in the document Laboratory Quality Assurance Program Plan (Radian Corporation, Research Triangle Park, June 30, 1988).

7.2 FIELD INSTRUMENTATION

Field instrumentation will be required to provide data concerning health and safety considerations and as a method for field screening samples. This section describes procedures to ensure that field instruments used throughout the RI Program are properly calibrated and that the calibrations are adequately documented. Proper calibration is required of all measuring and test equipment. Improperly calibrated field instruments will have serious negative impact on the precision and accuracy and thus the validity of the field measurements.

The calibration policies and procedures set forth will apply to all measuring and test equipment. This includes tools, gauges, instruments, standards and other devices/systems used to make measurements or used to monitor the safety of personnel and the environment. All measuring and test instruments fall into three general categories: those which are calibrated prior to each use, those which are calibrated on a scheduled or periodic basis, and those used for references.

All equipment which requires calibration will have an assigned identification number permanently affixed to the instrument. For measuring and test equipment requiring periodic calibration, a label will be kept with each instrument showing:

- o Description
- o Manufacturer
- o Model number
- o Serial number
- o Date of last calibration or maintenance
- o By whom calibrated/maintained
- o Due date of next scheduled calibration

A master list of all equipment used for the RI shall be prepared and maintained with the above information.

Calibration reports and compensation or correction figures will be maintained with the instrument. Thermometers are exempted from the labeling requirement, but not from the calibration requirement.

A written stepwise calibration procedure will be available for all measuring and test equipment prior to field work. Any instrument which is not calibrated to within the required specifications must display a warning tag to prevent the use of the equipment. Equipment unable to meet approved calibration specifications shall not be used. The required calibration ranges and uncertainties for each measuring and test device shall be documented.

7.2.1 Calibration Identification

Instruments past due for calibration or maintenance must be immediately removed from service, either physically or, if this is impractical, by tagging, sealing, labeling, or other means.

It shall be the responsibility of the field manager to ensure that all calibration and maintenance of equipment based on manufacturer

specifications or documented requirements is conducted prior to use. Likewise, the field manager shall be responsible for maintaining the required record-keeping system pertaining to calibration and maintenance of equipment including the tagging of equipment not meeting the required standards.

7.2.2 Calibration Standards

All physical, electronic, or chemical measurements or calibrations performed must be traceable, directly or indirectly, through an unbroken chain of properly conducted calibrations (supported by reports or data sheets). All measurements and calibrations shall be referenced to National Bureau of Standards (NBS) recognized standards or physical constants, or to standards prepared by nationally recognized procedures. Reports must be up-to-date for each reference standard and each subordinate standard used for calibration of measuring and test equipment. All standards shall have an uncertainty rating of no more than one-fourth of the specified uncertainty for the measuring or test equipment under calibration.

7.2.3 Calibration Frequency

At a minimum, calibration and maintenance intervals for field instruments must be those recommended by the respective manufacturers, unless experience dictates a shorter interval. When the manufacturer has not specified a calibration interval for the equipment, the interval will be established in writing by the user of such equipment and approved by the field manager. Adherence to the calibration schedule is mandatory. The fact that these calibrations may be performed by an outside source does not exempt the user from the responsibility for identifying, monitoring, and controlling calibration intervals and ensuring that maintenance checks are made on time.

Documentation of field instrument calibrations shall be the responsibility of the field manager. All calibration records shall be maintained in the field logbook. In addition, the following information shall be recorded in the notebook on a log sheet similar to Figure 7.1:

FIGURE 7.1

Sample Instrument Calibration

Make _____
Model # _____
Serial # _____

1. Recommended Calibration Frequency: _____
2. Last Calibration Date: _____
3. Calibrated By: _____
4. Calibration Standards Used: _____
5. Source of Calibration Standard: _____
6. Calibration Procedure Used if more than one method in manual
7.

<u>Usage Date</u>	<u>Sample ID Number</u>	<u>Location</u>
_____	_____	_____
_____	_____	_____

- o Equipment type (e.g., pH meter)
- o Manufacturer and model number
- o Serial number
- o Recommended calibration frequency
- o Date of latest calibration
- o Dates of field measurement (use)
- o Name of person who calibrated instrument
- o Calibration standards used
- o Source of calibration standards

Entries in the logbook shall be made at the beginning of each sampling or measuring effort and when each instrument is calibrated. All documentation in the logbook shall be made in ink. If an error is made, corrections shall be made by crossing a line through the error and entering the correct information. Changes shall be dated and initialed. No entries shall be obliterated or rendered unreadable. Records shall be kept for all instruments requiring calibration including, but not limited to:

- o pH meters
- o Specific conductance meters
- o HNu photoionization detectors
- o Organic vapor analyzers (OVA)
- o Explosimeters
- o Non-contact terrain conductivity meters
- o Oxygen meters
- o Flow meters
- o Digital thermometers
- o Survey equipment

8.0 ANALYTICAL PROCEDURES

The purpose of this section is to provide the analytical procedures required for each sample matrix and type. All analytical services other than for soil gas will be performed by Radian Laboratories. (Soil gas analytical procedures are described in Section 5.3.4). All analytical data generated by Radian will be under the CLP.

The Target Compound List (TCL) is divided into four major classes of analyses: volatiles, semi-volatiles (acid extractables, base/neutral extractables), pesticides/PCBs, and inorganics (metals). Analytical procedures for these compounds are described in detail in the USEPA Contract Laboratory Program documents Statement of Work for Organics Analysis, Multi-media, Multi-concentration (Rev. 7/87) and Statement of Work for Inorganics Analysis, Multi-media, Multi-concentration (Rev. 7/87).

Soils samples will be analyzed for a number of physical parameters for general site characterization. Physical soil analyses and their respective American Society for Testing and Materials (ASTM) method number are given below:

<u>Analysis</u>	<u>ASTM Method</u>
Natural Moisture Content	D-2216
Sieve Analysis	D-422
Hydrometer Analysis	D-422
Atterberg Limits	D-4318

During Phase II of the RI and during treatability testing of the FS, soil and ground water samples may be collected for additional characterization of the site or to assess the appropriateness of potential remedial technologies. Analyses may include total organic carbon (TOC) and cation exchange capacity (CEC) in soils and TOC, hardness and alkalinity in ground water. Should these analyses be required, the analytical procedures will be submitted to EPA for prior approval.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

This process condenses and verifies the large quantity of data associated with single analyses into single values that be used to accurately assess site conditions. Data reduction, validation and reporting are the responsibility of the laboratory, but regular checks will be conducted by SEC to ensure that the data is complete and correct.

9.1 DATA REDUCTION

The data analysis required to calculate sample concentrations is conducted according to the methods given in Section 8.0. At Radian, the reduction of this raw data is the responsibility of the analyst. The analyst records the results of analyses and all procedural modifications, deviations or problems associated with analyses in a parameter work book. The reduced data is then reviewed by the Laboratory Manager and transferred to the sample control area, where raw data are filed for subsequent review by the Quality Assurance Supervisor and/or Technical Director. Raw data, together with all supporting documentation, are stored permanently in confidential files by Sample Control. Data may be retrieved from archives upon request.

Data reduction and reporting are accomplished in conjunction with Radian's Sample and Analysis Management (SAM) System. SAM is a computer hardware and software system specifically designed for tracking and handling the large amount of information required for the efficient management of an analytical chemistry laboratory. The system provides a dynamic, easy-to-use method for the laboratory managers to obtain the information needed to quickly retrieve archived data. SAM allows tests to be retrieved by client, analysis, work order or completion date. Test results can be presented in standard or special formats.

9.2 VALIDATION OF DATA

After all analyses have been completed, a preliminary report is generated for review by the Laboratory Manager and the Quality Assurance Supervisor and/or Technical Director. Data integrity is ensured by their review, as

the Quality Assurance Supervisor and/or Technical Director includes a review of the data for adherence to the quality control objectives of the project.

Identification of outliers is also a part of the data review. An outlier is an unusually large (or small) value in a set of observations. There are many possible reasons for outliers. Among them are:

- o Faulty instruments or component parts;
- o Inaccurate reading of a record, dialing error, etc;
- o Errors in transcribing data; or
- o Calculation errors.

Sometimes analysts or operators can identify outliers by noting the above types of occurrence when they record observations. These faulty observations may then be removed from the data before being summarized. If no such information exists, the Dixon Criteria are used to test suspected outliers at the .5 percent significance level. (W. J. Dixon, "Processing Data for Outliers," Biometrics, 1953, Vol. 9, No. 1, 74-89).

Laboratory data are ultimately validated on the basis of the following or the basis of the following acceptance criteria:

- o Accuracy and precision of the method
- o Data representativeness
- o Data completeness
- o Method detection limits (matrix specific)
- o Calibration criteria

These criteria are described in detail in the Radian Laboratory Quality Assurance Program Plan. Data validation also includes internal quality control checks, as described in Section 10.0 of this document.

9.3 DATA REPORTING

Upon successful completion of the QA/QC process, data are submitted in final report form. Reporting format, content and quality will comply with CLP

requirements. This format consists of all pertinent sample and project information as originally provided in the sample log. Analyses for a given matrix, sample type and location will be presented on a summary sheet for inclusion in the RI appendices.

9.4 SEC REVIEW

SEC will conduct regular review of the analytical data to ensure that it complies with reporting and QA/QC requirements. Items to be reviewed include:

1. Completeness of Analytical Data - This criterion is a measure of the amount of valid data obtained from the measurement system compared with the amount that was expected under normal conditions.
2. Correctness of Analytical Data - This criterion is simply a check on all mathematical calculations, data transpositions, units of measure, significant figures, etc.
3. Accuracy - This criterion compares reported values to known values.
4. Precision - This criterion measures the reproducibility of a measurement.
5. Representativeness - In a laboratory setting, this criterion is usually evaluated according to the data's credibility, based on the QA representative's past experience with similar samples.

The SEC QC Manager will be responsible for assessing the data according to the given criteria.

10.0 INTERNAL QUALITY CONTROL

An internal quality control system is a set of routine internal procedures by the laboratory for assuring that the data output of a measurement system meets prescribed criteria for data quality. Inherent and implied in this control function is a parallel function of measuring and defining the quality of the data output. A well-designed internal QC program must be capable of controlling and measuring the quality of the data, in terms of precision and accuracy. Precision reflects the influence of the inherent variability in any measurement system. Accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter, and includes elements of both bias and precision. Accuracy of measurement data is related to the precision and bias of the component parts of the measurement system.

Generally, internal quality control procedures may be divided into two overlapping categories. One category includes those procedures which are used to control data quality within prescribed limits of acceptability. These acceptability limits are usually related to data precision, accuracy, and completeness. The other category includes those procedures designed to provide a quantitative assessment of data quality, again in terms of precision, accuracy, and completeness. Some internal QC procedures, by their nature, serve both control and assessment functions.

This section addresses QC procedures associated with analytical efforts. Included are general quality control considerations as well as specific quality control checks which provide ongoing control and assessment of data quality, in terms of precision and accuracy. Quality control checks which provide the basis for quantitative control and assessment of data quality, along with required frequency, acceptance criteria, and corrective action are summarized in the Radian Laboratory Quality Assurance Program Plan (LQAPP) (Rev. 0, June 30, 1988). Although outside the scope of this document, a brief discussion of sampling QC is presented below.

10.1 SAMPLING QC

Quality control procedures should be an integral part of each sampling methodology, and should include procedures which will ensure the collection of representative samples which are free from external contamination. Although different extraction and/or analytical procedures will be used for the various parameters of interest, certain general quality control procedures are applicable to most sampling methods. These include the following:

- o Field blanks should be collected routinely, at a minimum frequency of one per twenty samples (5%). Field blanks will be sample containers (jars and vials) which are handled (i.e., opened, sealed, and transported) in the same manner as actual sample containers. Samples will be analyzed for volatile organic compounds, the most likely form of potential contamination;
- o Split samples for matrix spike and matrix spike duplicate samples should be collected at a frequency of 5% (1 set per 20 samples) to provide a measure of method variability (i.e., total variability due to imprecision in both sampling and analytical procedures). At least one MS/MSD sample should be taken for each type of sample taken over the course of a specific sampling period;
- o Chain-of-custody forms should accompany all samples; and
- o Sampling apparatus should be thoroughly cleaned between each sampling to prevent cross-contamination of the samples.

In addition to these general sampling QC requirements, additional QC procedures should be performed as part of the analytical methods. These are discussed below.

10.2 LABORATORY QC

10.2.1 EPA GC Methods

Analytical quality control procedures for GC analyses are described generally in Method 8000 of SW846, 3rd ed. and include the following:

- o Initial demonstration of capability;
- o Calibration verification;
- o Analysis of surrogate spiked samples;
- o Reagent (method) blank analyses;
- o Analysis of matrix spike/matrix spike duplicates;
- o Duplicate sample analyses (EPA 600 series);
- o Analysis of QC check samples and/or method spikes, and
- o Retention time window checks.

These procedures are described below.

Initial Demonstration of Capability -- Before analyzing samples by a method, the laboratory must demonstrate the ability to generate accuracy and precision. This is done by analyzing four aliquots of a QC check sample (QCCS) by the same procedure used to analyze samples. The laboratory should calculate the average recovery and the standard deviation of the recovery for each analyte of interest using the four results. The mean recovery and standard deviation for each analyte should be compared with the corresponding acceptance criteria published in the SW846 method. If the experimental accuracy and precision data are acceptable, analyses may proceed; if not, remedial action must be taken to improve system performance.

Surrogate Spikes -- A surrogate standard is a chemically inert compound not expected to occur in an environmental sample. The use of surrogate compounds may be project dependent, and limited by the ability to select a suitable surrogate for a particular parameter class. Recommended surrogate compounds and method recovery acceptance limits for GC methods are in the LQAPP. If the surrogate spike recovery in any sample is not within limits:

- o Check for errors in calculations, surrogate solutions and standards. Check instrument performance.
- o Recalculate the data and/or reanalyze the extract if any of the above checks reveals a problem.
- o Re-extract and reanalyze the sample if none of the above are a problem, or flag the data as "estimated concentration".

Reagent (Method) Blank Analyses -- Before processing any samples, the analyst should demonstrate through the analysis of a reagent water method blank that all glassware and reagents are interference-free. Each time a set of samples is extracted or there is a change in reagents, a method blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps. Lack of contamination is demonstrated if all target analytes with the exception of common laboratory reagents are present at less than their Method Detection Limits (MDLs). Two common reagents, methylene chloride (E601/SW8010) and toluene (E602/SW8020), must not exceed five (5) times their MDLs.

QC Check Sample Analyses -- QC check samples may be obtained from EPA or prepared from suitable reference materials, but must be prepared independently of calibration standards. The QCCS should contain the analyte(s) of interest at a concentration in the mid-calibration range. A QCCS must be analyzed if matrix spike recoveries are unacceptable to verify that the analytical system is in a state of control.

Matrix Spike/Matrix Spike Duplicate Analyses (MS/MSD) -- SW846 protocol recommends analysis of matrix spike and matrix spike duplicate samples for each analytical batch or matrix type (5 percent minimum frequency). The method recovery limits and relative percent difference (RPD) acceptance criteria are given in the LQAPP. When matrix spike results fall outside limits published in the respective methods, a QCCS must be analyzed to demonstrate analytical control. If spike recoveries are outside normal limits due to matrix problems, the data should be flagged.

Retention Time Windows -- The laboratory will calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. To establish windows, make three injections of all single component standard mixtures and multi-response products (e.g., PCBs) throughout the course of a 72-hr period. Calculate the standard deviation of the three absolute retention times for each single component standard. For multi-response products, choose one major peak from the envelope. If the standard deviation for a particular standard is zero, substitute the standard deviation of a close eluting, similar compound to develop a valid retention time window.

The laboratory will establish daily retention time windows for each analyte. Use the absolute retention time for each daily calibration standard as the midpoint of the window for that day. The daily retention time window equals the midpoint \pm three times the standard deviation determined above. All succeeding standards in an analysis sequence must fall within the daily retention time window established by the first standard of the sequence.

10.2.2 EPA GC/MS Methods

Analytical quality control procedures for GC/MS analyses are described generally in Method 8000 of SW846, 3rd ed. and include:

- o Initial demonstration of capability;
- o Calibration verification;
- o Surrogate standard spike samples;
- o Reagent (Method) blank analyses;
- o Matrix spike duplicate analyses;
- o Analysis of duplicate samples (EPA 600 series);
- o Mass spectrometer sensitivity check; and
- o Daily GC/MS performance tests.

Initial Demonstration of Capability -- Before analyzing samples by a method, the laboratory must demonstrate the ability to generate acceptable accuracy and precision. This is done by analyzing four aliquots of a QC

check sample (QCCS) by the same procedure used to analyze samples. The laboratory should calculate the average recovery and the standard deviation of the recovery for each analyte of interest using the four results. The mean recovery and standard deviation for each analyte should be compared with the corresponding acceptance criteria published in the SW846 method. If the experimental accuracy and precision data are acceptable, analyses may proceed; if not, remedial action must be taken to improve system performance.

Surrogate Spikes -- All samples are spiked with surrogate standards as described in SW846. If the surrogate spike recovery in any sample is not within limits:

- o Check for errors in calculations, surrogate solutions and standards. Check instrument performance.
- o Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem.
- o Re-extract and reanalyze the sample if none of the above are a problem, or flag the data as "estimated concentration".

Reagent (Method) Blank Analyses -- A reagent (method) blank should be analyzed every 12 hours to demonstrate that analytical system interferences are below acceptable limits. The blank samples should be carried through all stages of the sample preparation (including extraction for semivolatiles) and measurement steps. Lack of contamination is demonstrated if all target analytes with the exception of common laboratory contaminants are present at less than their MDLs. For volatile analyses (E624/SW8240) the common laboratory contaminants, methylene chloride, acetone, 2-butanone and toluene, must not exceed five (5) times their CLP contract required quantitation limits (CRQLs). For semi-volatile analyses (E625/SW8270) the common laboratory contaminants, phthalate esters, must not exceed five (5) times their CLP CRQLs.

Calibration Verification -- Instrument tuning and calibration procedures are described in the LQAPP.

QC Check Sample Analyses -- QC check samples may be obtained from EPA or prepared from suitable reference materials, but must be prepared independently of calibration standards. The QCCS should contain the analyte(s) of interest at a concentration in the mid-calibration range. A QCCS must be analyzed if matrix spike recoveries are unacceptable to verify that the analytical system is in a state of control.

Matrix Spike/Matrix Spike Duplicate Analyses (MS/MSD) -- SW846 protocol requires analysis of matrix spike and matrix spike duplicate samples for each analytical batch or matrix type (5 percent minimum frequency). When matrix spike recoveries fall outside limits published in the respective methods, a QCCS must be analyzed to demonstrate analytical control. If spike recoveries are outside normal limits due to matrix problems, the data should be flagged.

Mass Spectrometer Sensitivity Check -- If the extracted ion current profile (EICP) area for any internal standard changes by more than a factor of two (-50% - +100%), the mass spectrometer must be inspected for malfunctions and corrective action taken. Samples analyzed while the system was malfunctioning must be reanalyzed.

Daily GC/MS Performance Tests -- Each day that analyses are performed, the GC/MS system will be checked using bromofluorobenzene (BFB) or decafluorotriphenylphosphine (DFTPP). If all criteria are not met, the instrument will be returned and the test repeated until all criteria are achieved.

10.2.3 EPA Metals Methods

Metals Analyses by ICPEs and Atomic Absorption -- The quality control procedures associated with metals analyses are described in SW846 Method 6010 (EPA Method 200.7) for ICPEs and Method 7000 (EPA Methods 206.2, 270.2, 245.1, 239.1) series for atomic absorption, and include:

- o Calibration verification;
- o Analysis of QC check samples;
- o Calibration blank analyses;
- o Reagent blank analyses;
- o Analysis of matrix spike/matrix spike duplicates;
- o Instrument check standard analyses; and
- o Interference blank analyses.

These procedures are described below.

Calibration -- Calibration procedures are described in the LQAPP.

QC Check Sample Analyses -- Immediately after calibration, a quality control check sample (QCCS) containing all elements of interest is analyzed. The results are calculated prior to analyzing any other samples. If the measured value differs from the theoretical value for any parameter by more than $\pm 10\%$, these parameters will be restandardized. The QC standard is prepared from a stock standard solution which is different than that from which the calibration standards were prepared. Alternatively, it may be purchased from a commercial source. The QCCS should be prepared in the same acid matrix as the calibration standards at 10 times the instrumental detection limit or in the mid-calibration range.

After every 10 samples, the QC standard is reanalyzed. If the measured value differs from the theoretical value by more than $\pm 10\%$ for ICPEs, or $\pm 15\%$ percent for AAS, recalibrate the instrument.

Calibration Blank (ICPEs) -- At a frequency of 10 percent, a calibration blank is analyzed during sample analyses. As specified in Method 6010, this standard is prepared by diluting 2 mL of (1+1) HNO_3 and 10 mL of (1+1) HCl to 100 mL DI H_2O . If response to this standard is verified to be outside three standard deviations of the mean calibration blank value, then correct the problem, recalibrate, and reanalyze the previous ten samples.

Reagent Blank -- A reagent blank, containing all the reagents and in the same volumes as used in the processing of the samples and carried through

the complete preparation/analysis procedure, should be analyzed at a minimum frequency of 5 percent, or one per sample batch. Reagent blank results should be used to correct for possible contamination resulting from varying amounts of the acids used in processing samples.

Matrix Spike/Matrix Spike Duplicate -- For each analytical batch or matrix type (5 percent minimum frequency), matrix spike and matrix spike duplicate samples should be analyzed. Matrix spike results should fall within 85-115 and 75-125 percent recovery of the spike for water and soil matrices, respectively. If the spike is not recovered within the specified limits, the data should be flagged as suspect due to matrix effects. Depending on the project, provisions should be established to use standard-addition analysis procedures to compensate for matrix effects.

Duplicate spiked sample results should agree within 20 percent RPD for waters and 30 percent RPD for soils. If they do not, evaluate the system for the source of the imprecision, and correct the problem.

Instrument Check Standard (ICPES) -- The instrument check standard is composed of compatible elements at a concentration equivalent to the midpoint of their respective calibration curves. This standard will be analyzed at a frequency of 10% of the samples. If response to any parameter is verified to be outside $\pm 5\%$ of the true value, the instrument must be recalibrated before sample analysis continues.

Interference Check Standard (ICPES) -- The interference check standard will be analyzed at the beginning, end, and at intervals during analysis of a batch of samples. This standard contains the analytes of interest at minimal concentrations and by known concentration of interfering elements. If results exceed 1.5 times the standard deviation of the mean analysis value for this standard, instrument recalibration must be performed before sample analysis may proceed.

10.2.4 Establishment of Laboratory Control Limits

The laboratory has a quality control program in place designed to minimize random errors, monitor accuracy, monitor precision, and flag emerging systematic problems. Their program consists of regular analysis of method spikes (QC check samples) for all high volume production analyses. The minimum frequency is one per week with most analyses having a higher frequency based on method protocols. Control charts for the accuracy (percent recovery) will be routinely maintained for the selected indicator compounds given in the LQAPP. These charts are prepared using the control charting capabilities of the SAM laboratory information management system (LIMS). Updated control charts can be generated weekly.

Action limits for control samples are used to indicate variability in results due to systematic or assignable as opposed to random or unassignable causes. Typical control limits are maintained at $\pm 2 S$ (S = standard deviation) for warning limits and $\pm 3 S$ for action limits. Laboratory control limits for the indicator compounds are determined after 21 data points have been charted. Tables of these control limits plus the corresponding control charts are maintained at the appropriate work station in each laboratory. These control limits will be updated periodically following the accumulation of 21 additional data points. An out-of-control situation is identified by:

- o a value outside the tabulated laboratory control limits or control charted action limits,
- o a series of seven successive points on the same side of the central line (mean recovery value); or
- o a series of five successive points going in the same direction.

An out-of-control situation must be documented on a Radian Malfunction Report and reported to the QA manager.

The results for non-indicator compounds are also monitored in real time. When a recovery for a non-indicator parameter falls outside a recovery window quoted in the method, a control chart for that parameter is generated to determine if a systematic trend is developing.

11.0 QUALITY ASSURANCE AUDITS

The purpose of a quality assurance audit is to provide an objective, independent assessment of a measurement effort. The quality assurance audit ensures that the laboratory's data generating, data gathering, and measurement activities produce reliable and useful results. Cases can occur in which inadequacies are identified in the measurement system. In such cases, audits provide the mechanism for implementing corrective action.

Quality assurance audits play an important role in Radian's overall QA/QC program. This section describes the role of the QA auditor and the nature of quality assurance audits.

The QA auditor is the person who designs and/or performs QA performance and systems audits. Since QA audits represent, by definition, independent assessments of a measurement system and associated data quality, the auditor must be functionally independent of the measurement effort to ensure objectivity. However, the auditor must be familiar enough with the objectives, principles, and procedures of the measurement efforts to be able to perform a thorough and effective evaluation of the measurement system. Especially important is the ability to identify components of the system that are critical to overall data quality. For this reason, the audit focuses heavily upon those elements. The auditor's technical background and experience should also provide a basis for appropriate audit standard selection, audit design, and data interpretation.

Radian's organizational structure ensures the independence of the QA function. A QA Coordinator is given the responsibility for management and execution of audit activities. The QA Coordinator reports to the QA Director on all QA-related matters. The QA Director may initiate corrective action. The QA Coordinator is responsible for designing and performing both performance and systems audits.

Quality assurance audits of Radian's laboratories may include both internal and external audits. External audits are those conducted by an independent organization such as NIOSH or the U.S. EPA, and may include participation in

interlaboratory comparison studies and certification testing. Internal audits are conducted by Radian QA personnel. Radian's Corporate Quality Assurance Program includes regularly scheduled performance and systems audits of every laboratory in the Chemistry Division.

Radian performs several types of audits. The following paragraphs describe the purpose of several types of audits and identify the questions that are, and are not, addressed by each type of audit.

11.1 TECHNICAL SYSTEMS AUDITS

A technical systems audit is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. The technical systems audit is an assessment of overall effectiveness, and represents an objective and insightful evaluation of a set of interactive systems with respect to strengths, deficiencies, and potential areas of concern. Typically, the audit consists of observations and documentation of all aspects of the measurement effort.

Radian's technical systems audits are based on the approved Quality Assurance Project Plan (QAPP). These audits review questions regarding:

- o Calibration procedures and documentation;
- o Completeness of data forms, notebooks, and other reporting requirements;
- o Data review and validation procedures;
- o Data storage, filing, and recordkeeping procedures; Sample custody procedures;
- o Quality control procedures and documentation;
- o Operating conditions of facilities and equipment;

- o Documentation of maintenance activities; and
- o Systems and operating overview.

Radian prepares detailed systems audit checklists prior to each audit. These delineate the critical aspects of each methodology and measurement system. Checklists are used by the Radian auditor(s) to document all observations. The checklists are based on audit criteria specified by the Quality Assurance Officer (QAO) and the applicable QAPP.

Technical Systems Audits do not answer quantitative questions about the measurement system. The organization's policies regarding the role of Quality Assurance are not answered. Concerns involving assessments of the data quality indicators are also not addressed.

11.2 PERFORMANCE EVALUATION AUDITS

The purpose of performance evaluation audits is to quantitatively assess the measurement data quality. These audits provide a direct evaluation of the various measurement systems' capabilities to generate quality data. This evaluation is accomplished by challenging the measurement system with accepted reference standards.

Performance evaluation audits answer questions regarding the following:

- o Accuracy and precision of the measurement system;
- o The quality control data as compared to the actual data collected;
- o The measurement system as a function of established control limits; and
- o Significant deviations of the quality over time.

Although the answers to these questions will help determine when a system is out of control, the appropriate corrective action may not always be evident.

Questions regarding qualitative issues, such as management policies, sample custody procedures, recordkeeping, and data handling systems are not addressed in a performance evaluation audit.

11.3 AUDITS FOR DATA QUALITY

The purpose of audits for data quality is to assess data quality indicators. Audits for data quality provide information required to characterize data quality by answering questions regarding:

- o Adequacy of data recording and transfer;
- o Precision of bias of resultant data;
- o Adequacy of data calculation, generation, and processing;
- o Documentation of procedures; and
- o Identification of data quality indicators to inform users of limitations and applicability.

Audits of data quality answer questions of whether the data collection efforts need modifications, and whether the documentation of quality control procedures is adequate. Audits of data quality do not, however, answer technical questions such as those concerning the operating conditions of facilities and equipment.

11.4 POST-AUDIT DEBRIEFING

Following each audit, a post-audit debriefing session is conducted. The purpose of this session is to discuss preliminary audit results with the audit participants. If the audit reveals a critical deficiency, a Recommendation for Corrective Action will be issued (see Section 11 of this manual). The debriefing session is followed by a detailed audit report that identifies areas of concern and recommendations for corrective actions.

12.0 PREVENTIVE MAINTENANCE

12.1 LABORATORY

The primary objective of a preventative maintenance program is to help ensure the timely and effective completion of a measurement effort. The preventative maintenance program at Radian's laboratory is designed to minimize the downtime of crucial sampling and/or analytical equipment due to expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas:

- o Establishment of maintenance responsibilities;
- o Establishment of maintenance schedules of major and/or critical instrumentation and apparatus; and
- o Establishment of an adequate inventory of critical spare parts and equipment.

12.1.1 Maintenance Responsibilities

Maintenance responsibilities for permanently assigned equipment are assigned to the respective Laboratory Managers. The Laboratory Managers then establish maintenance procedures and schedules for each major equipment item. Responsibilities for specific items may be delegated to laboratory personnel, although the Laboratory Managers retain responsibility for ensuring adherence to prescribed protocol.

12.1.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. A specific schedule is established for all routine maintenance activities. Other maintenance activities may also be identified as requiring attention on an as-needed basis. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service

contracts provide primary maintenance for many major instruments (e.g., GC instruments, mass spectrometers, atomic absorption spectrometers, analytical balances, etc.). All aspects of routine and nonroutine instrument maintenance are recorded in logbooks, and a logbook is dedicated too each instrument.

12.1.3 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment downtime. This inventory should emphasize those parts (and supplies) which:

- o are subject to frequent failure;
- o have limited useful lifetimes; or
- o cannot be obtained in a timely manner should failure occur.

Laboratory Managers are responsible for maintaining an adequate inventory of necessary spare parts.

12.2 FIELD EQUIPMENT

An inventory control system including all field equipment and instrumentation used by SEC is maintained by the laboratory manager as the basis for maintenance and calibration control. The inventory control documentation includes the following:

- o Description of item
- o Manufacturer, model number and serial number
- o SEC's identification number
- o Name, address, and telephone number of the company which services the item
- o Type of service policy
- o Timing and frequency of routine maintenance, servicing, and calibration

Routine maintenance is the responsibility of the laboratory manager. Malfunctioning equipment must be reported to the laboratory manager with a description of the problem, source of the problem (if known) and field situations at the time of failure. It is the responsibility of the SEC laboratory manager to see that defective equipment is repaired correctly.

13.0 CORRECTIVE ACTION PROCEDURES

Corrective action may be required when a nonconformance or deficiency is identified during review of laboratory or field activities. Nonconforming items may be identified during a formal audit by EPA or Versar, its oversight contractor, or during a routine SEC quality control audit. After identification a nonconforming item will be reported to the project QA manager. The QA manager will then assign an appropriate project worker to remedy the nonconformance and document any corrective actions. The POP will be revised accordingly to avoid repetition of any nonconformance. Specific requirements for field and laboratory activities are discussed below.

13.1 ACTIVITIES

All technical staff shall be responsible for reporting all suspected technical nonconformances by initiating a nonconformance report of any site activity or document. A sample nonconformance report is given in Figure 13.1. All staff shall be responsible for reporting all suspected quality assurance nonconformances by initiating a nonconformance report.

The QA manager will be responsible for ensuring that corrective actions for nonconformances are implemented by:

- o Evaluating all reported nonconformances
- o Controlling additional work on nonconforming items
- o Determining disposition or action to be taken
- o Maintaining a log of nonconformances
- o Reviewing nonconformance reports
- o Evaluating disposition or action taken
- o Ensure nonconformance reports are included in the final site documentation in document control

Any staff member who discovers or suspects a nonconformance, which is an identified or suspected deficiency in a site investigatory activity or an approved document, is responsible for initiating a nonconformance report.

FIGURE 13.1

SIRRINE ENVIRONMENTAL CONSULTANTS
NONCONFORMANCE REPORT

Date: _____ Time: _____

Location: _____

Activity/Document: _____

Personnel: _____

Site Conditions (if applicable): _____

Describe Nonconformance: _____

Suggested Remedy: _____

Submitted By: _____

Review by QA Manager: _____

Review by Site Project Manager: _____

Actual Remedy: _____

Remedy Implemented: _____

Date: _____

Documentation: _____

Formal audits will be responded to within 30 days of receipt of the audit by the QA manager.

The site manager shall ensure that no additional work, which is dependent on the nonconforming activity, is performed until the nonconformance report is corrected.

Responsibilities

The site manager will be responsible for carrying out corrective action as initiated by the project QA manager. The site manager shall evaluate each nonconformance report and shall provide a disposition by signing the appropriate entry and describing the remedy to be implemented. All nonconformance reports will be routed to the SEC project manager to ensure final resolution of all issues.

13.2 LABORATORY ACTIVITIES

Control charts are used to monitor variations in the precision or accuracy of routine analyses and can detect trends in these variations. Construction of a control chart requires an initial data base to establish the mean and standard deviation of measurements. The data base will consist of measurements obtained from performing the complete analytical method. These control charts fall into two categories: precision control charts and accuracy control charts. Data falling outside the upper control limit or the lower control limit of either of these charts indicates an "out-of-control" situation. Corrective actions will be taken to ascertain the cause of the out-of-control situation, as follows:

Precision

Precision is a measure of mutual agreement among individual measurements of the same parameter. As data is plotted on the control chart, the data will be pooled with previous data to calculate a new mean and standard deviation for controlling subsequent analyses. In determining the new mean and standard deviation, the new data should be combined with previously found

concentrations and not the mean of the previously found concentrations. Except for the data obtained from standard samples, no data may be discarded unless sufficient reason can be cited to justify the discarding process. That a point is beyond control limits is not sufficient justification to discard the point.

Accuracy

Accuracy is a measure of the bias inherent in the analytical system. The accuracy of sample analyses will be evaluated through examination of the relative percent differences (RPD) between the matrix splice and matrix splice duplicates. The RPD is calculated as:

$$RPD = 100 * \frac{(X - T)}{T}$$

where

X = measured value

T = actual (reference) value

Samples outside the requirements of the CLP protocols for RPD, considering the analysis and media, will be identified as being out of acceptable control and potentially requiring corrective action. Confirmation of the given values with the laboratory will be the first stage of corrective action assessment. No data may be discarded unless sufficient reason can be documented. Being outside control limits alone is not sufficient justification to discard a data point.

APPENDIX A
MEDLEY FARM SITE REMEDIAL INVESTIGATION/FEASIBILITY STUDY
HEALTH AND SAFETY PLAN

SEPTEMBER, 1988

SEC JOB NO. G-8026

SIRRINE ENVIRONMENTAL CONSULTANTS
GREENVILLE, SOUTH CAROLINA

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1.0 COORDINATION AND RESPONSIBILITY

The Project Manager must not allow work to begin until this Health and Safety Plan has been provided to all field personnel. Before visiting the work site, all personnel must attend a site-specific briefing session, to be conducted by the SEC Health and Safety Director or his designee, on the potential site hazards and specific requirements of this Health and Safety Plan, including training in the proper function and operation of all monitoring and personal protective equipment. The overall responsibility for the health and safety of SEC project personnel lies with the SEC Health and Safety Director. The Site Health and Safety Officer (HSO) (the senior SEC representative continually on site during any site activity) will be responsible for ensuring that the Site-specific Health and Safety Plan is complied with during site operations. If there is any question whether an unplanned occurrence on site may compromise health and safety, the HSO has the authority to interrupt operations and to remove all personnel from the area. If practical, the Project Manager and Health and Safety Director should be consulted before any operation is interrupted. If work is stopped due to any health and safety concern, immediate attention should be given by health and safety personnel, working in cooperation with the Project Manager, to identify and correct the cause of concern as quickly as possible. Any such incident should be fully documented by the Site Health and Safety Officer in a report to the Health and Safety Director and Project Manager. In the event of a work stoppage, the client must be notified as soon as possible, and kept apprised of progress in resolving the incident until normal operations are resumed.

NOTE: REFER TO PAGE 45 FOR EMERGENCY CONTACT NUMBERS:

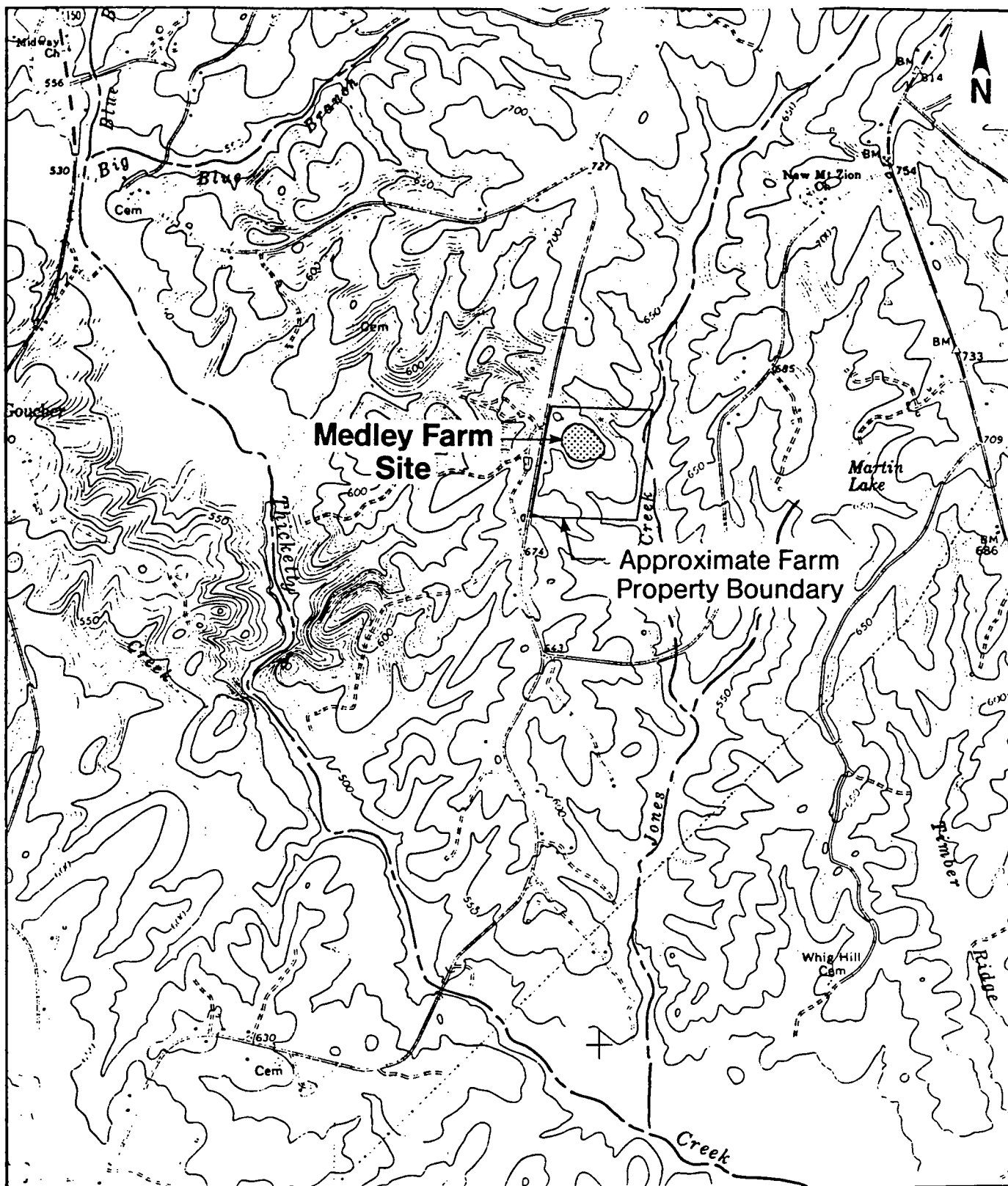
2.0 SITE DESCRIPTION

The Ralph Medley Farm occupies 61.9 acres of rural land approximately six miles south of Gaffney, South Carolina in Cherokee County on County Road 72 (Burnt Gin Road). The approximate property boundaries are shown in Figure A-1. The Medley Farm site consists of an approximately 7-acre section of the Ralph Medley Farm parcel that is situated on top of a small hill. The approximate center of the site is located at latitude 34°58'54" north and longitude 81°40'2" west. The surrounding land is hilly and consists mainly of woods and pasture land. The land use in the vicinity of the site is primarily agricultural (farms and cattle) and light residential.

The Medley Farm site ranges in elevation from 680 to 700 feet above mean sea level. Topography of the site area is relatively flat but the adjacent land slopes off steeply to the east and south. Surface water drainage from the site flows into Jones Creek, located along the eastern property boundary. Jones Creek flows into Thicketty Creek which then drains into the Broad River.

The Medley (also known as Burnt Gin) Farm is owned by Ralph C. Medley, who acquired the property from William Medley in 1948. Prior to the mid-1970s, the site was maintained as woods and pasture land. Available information indicates that disposal of drummed and other waste materials began at the site in 1973. Waste disposal at the Medley site reportedly stopped in June 1976. At the time of the South Carolina Department of Health and Environmental Control (SCDHEC) inspection (May 3, 1983), approximately 2,000 55-gallon drums were stored on site in a random fashion. Some were in open pits or one of six small lagoon areas. No formal records of disposed waste materials were kept at the Medley Farm Site.

Areas of distressed vegetation were noted where drum discharges may have occurred. In addition to the 55-gallon drums, there were several hundred plastic containers of various sizes. Most of these drums were



USGS Pacolet Mills Quadrangle (1969)

Scale 1:24,000

Figure A-1

Approximate Boundaries of Medley Farm Site and Farm Property

Medley Farm Site Gaffney, South Carolina



in a condition that markings were no longer visible. Contents of most drums could not be identified.

Based on this inspection, SCDHEC returned on May 19, 1983 to collect samples of drum contents and soils for analysis. Results of analyses reported a number of volatile organics, including methylene chloride, trichloroethylene and trans-1,2-dichloroethylene, and base neutral extractable compounds. No acid extractable compounds were detected among the analyses performed.

SCDHEC informed EPA of the sampling results and EPA visited the site during the week of May 30, 1983. Samples were collected for analysis. Among the contaminants found were: methylene chloride, vinyl chloride, tetrachloroethylene, phenol, toluene, trichloroethylene and 1,2-dichloroethane. One on-site composite soil sample contained polychlorinated biphenyls (PCBs) at low levels.

An emergency removal action was initiated on June 20, 1983 by O.H. Materials Company pursuant to Section 104 and other provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A total of 5,383 drums and 15-gallon containers were removed from the site.

The liquids were bulked (24,200 gallons) and taken off-site by tanker and incinerated. The solid waste and contaminated soils, totalling 2132 cubic yards, were taken to an approved hazardous waste landfill. Three drums containing PCBs were overpacked and sent to an approved disposal facility. An estimated 70,000 gallons of water were drained from the six small lagoons and treated in a pressurized sand/gravel/activated carbon filtration system for the removal of organics. The treated effluent was analyzed to ensure it met State discharge standards prior to release into Jones Creek. The lagoons were then backfilled with clean earth and graded to the natural topography. Remedial actions were completed on July 21, 1983.

Analytical testing of the drum contents, as well as the water and sediment in the lagoons during the removal action, indicated the presence of organic compounds. These included: toluene, benzene, methylene chloride, tetrachloroethylene and vinyl chloride. Samples from adjacent homeowners' wells were collected by SCDHEC on June 23, 1983 and found to contain methylene chloride.

NUS conducted a geological and geophysical study of the Medley Farm site at the direction of EPA during August, 1983 to determine the potential for ground water contamination at the site. The study included a literature search and geophysical investigation. The results of the geophysical survey indicated that suspected subsurface contaminants may have migrated as much as several hundred feet to the southeast, but this is based only on this screening procedure and has not been verified with any sampling. The NUS report stated that the suspected contaminants were most likely confined to the soil layer above the impermeable bedrock.

SCDHEC revisited the site in April of 1984 to perform a preliminary site investigation and install a monitoring well. An attempt to construct well MD2 (Figure A-2) was ended when the borehole reached 54 feet without encountering saturated conditions due to auger refusal. A second borehole was advanced at a lower elevation (MD2A in Figure A-2) that encountered saturated conditions at 65 feet and a monitoring well was installed. Soil from both boreholes and ground water from the well were analyzed for volatile organics, primary metals, acid and base-neutral extractables. Volatile organic analyses of soil taken at 10 feet in borehole MD2 showed 81.4 ug/kg of methylene chloride and 102 ug/kg of 1,2-dichloroethane. Ground water sampling results for the volatile organics are given in Table A-1.

The Medley Farm site was subsequently evaluated by the U.S. EPA in June 1985, using the Hazard Ranking System (HRS). A migration score of 31.58 was assigned based entirely on the ground water route. The

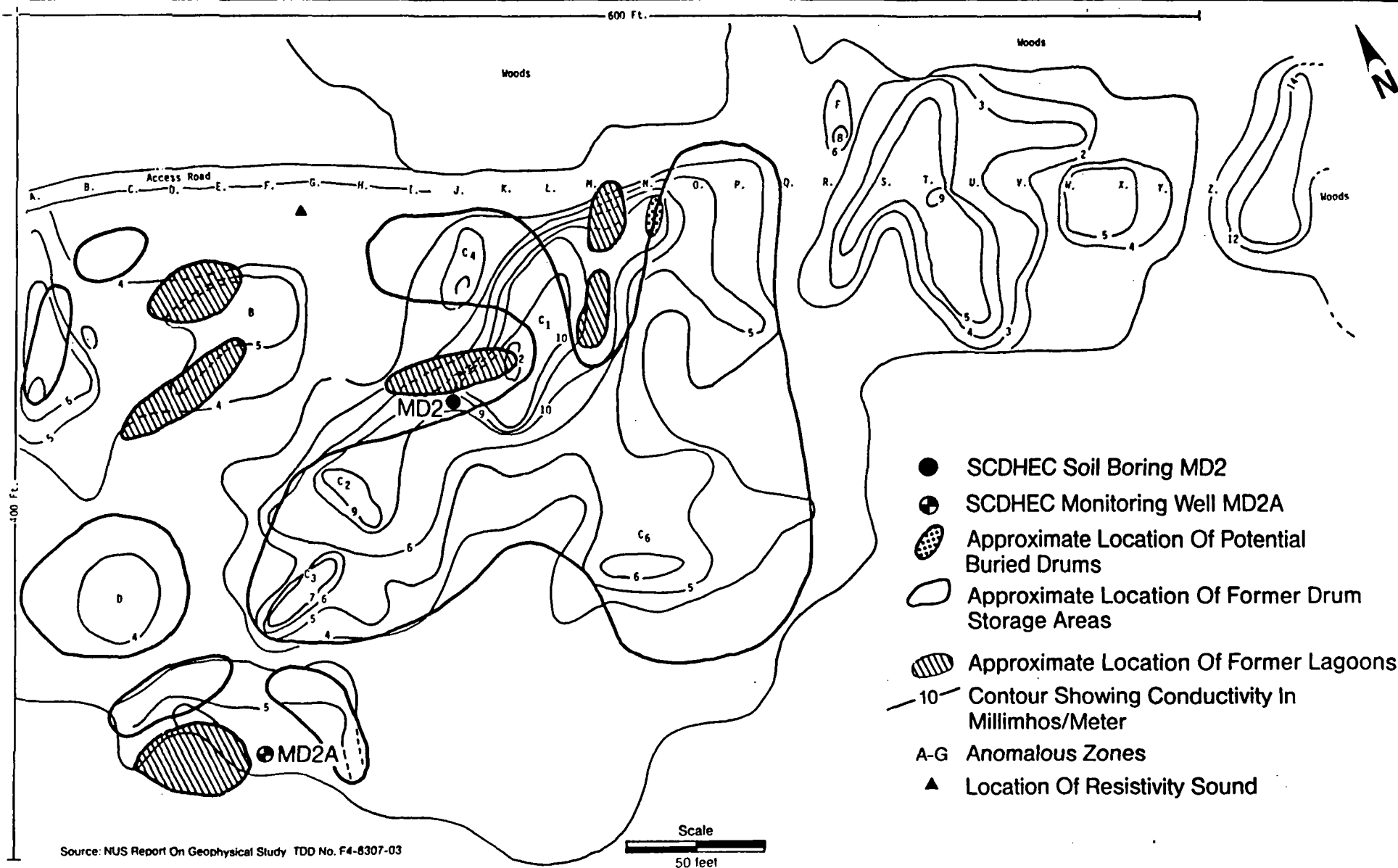


Figure A-2

Approximate Locations Of Former Drum Storage Areas And Lagoons

Medley Farm Site Gaffney, South Carolina



TABLE A-1

GROUND WATER ANALYSES AT THE MEDLEY FARM SITEVolatile Organic Analysis - Well MD2A

Date of Collection

	<u>April 13, 1984 (1)</u>	<u>July 18, 1984 (2)</u>
1) methylene chloride	39.05 ug/l	9.22 ug/l
2) 1,1-dichloroethene	1,887 ug/l	1,645 ug/l
3) 1,1-dichloroethane	160.5 ug/l	43.7 ug/l
4) trans-1,2-dichloroethene	37.9 ug/l	28.0 ug/l
5) chloroform	8.0 ug/l	3.56 ug/l
6) 1,2-dichloroethane	22.05 ug/l	7.53 ug/l
7) 1,1,1-trichloroethane	3,362 ug/l	2,188 ug/l
8) carbon tetrachloride	3,804 ug/l	830 ug/l
9) trichloroethene	6.6 ug/l	3.143.9/l
10) 1,1,2-trichloroethane	66.9 ug/l	15.3 ug/l
11) toluene	29.6 ug/l	*
12) tetrachloroethene	2.5 ug/l	*

Volatile Organic Analysis - Sprouse Well (2)

1) methylene chloride	678 ug/l
2) 1,2-dichloroethane	2.51 ug/l

* No value given in SCDHEC analytical results.

SOURCE: SCDHEC, 1984, As referenced in the SEC RI/FS Work Plan (August, 1988).

Medley Farm Site was proposed for addition to the National Priorities List (NPL) in June 1986. The extent of potential residual soil contamination is unknown. Any contaminated soil on-site was either removed by past remediation efforts or covered with clean earth during the immediate response action. "Numerous pockets of buried gelatinous material" were found by SCDHEC, during installation of a monitoring well in April 1984. These were observed and noted by EPA during the May 1988 site visit. No sampling of surface waters or sediments has been done in Jones Creek, the Big Blue Branch, or Thicketty Creek.

All visible drums were removed from the site during the emergency action in June-July of 1983. The electromagnetic survey conducted in August of 1983 indicated the potential for buried drums remaining on-site is unlikely except in one small area. This area will be confirmed during RI test pitting activities. Sludge was removed from the six small lagoons during the emergency action as well. The lagoons are currently covered with clean earth and graded to the surrounding topography. The type and extent of residual soil and ground water contamination, if any, is presently unknown.

The Medley property is no longer in use as a farm. While there are no barriers to prevent access by the public, the site is in a remote location and should receive little traffic.

3.0 PROJECT DESCRIPTION

This Health and Safety Plan has been prepared for the Medley Farm Site Remedial Investigation which will be conducted by Sirrine Environmental Consultants for the Medley Farm Site Steering Committee. The RI field investigations will be conducted in a series of phases. The break between Phase IA and Phase IB will be for the evaluation of TCL (Target Compound List) analyses, serving as source characterization, and the development of a site-specific list of indicator parameters to be used for subsequent analyses. The major elements of each phase are outlined below:

Phase IA Field Investigations will include:

- A soil gas survey to confirm the selection of appropriate locations for source characterization efforts,
- Excavation of eight (8) test pits for initial source characterization,
- Installation of four (4) well pairs (8 wells) for ground water sampling and periodic (bi-monthly at minimum) water level measurement,
- Phase IA ground water sampling (two well pairs -- MW-2 and MW-4),
- Hydraulic testing (slug tests),
- TCL analyses of four (4) ground water samples and eight (8) soil samples.

Phase IB Field Investigations will include:

- Soil borings for additional source characterization (12),
- Up to seven additional test pits,
- Surface water and sediment sampling,
- Ground water sampling of all monitoring wells,
- Hydraulic testing (pump test),
- Sediment and surface water sampling,
- Analyses of ground water, soil, stream sediment and surface water samples for the list of indicator parameters developed during Phase IA.

Phase II

The need for additional sampling and analyses or other efforts necessary to support the risk assessment and development of remedial alternatives will be evaluated after completion of Phase I. If additional well pairs are required, well construction, sampling, and drilling operations will be conducted as described for Phase I.

4.0 HAZARD ASSESSMENT

General Chemical Hazards

Table A-2 presents a variety of inhalation limits applicable to workplace exposures for organic contaminants found at the Medley site. The American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Values (TLVs) for the work environment are given for volatile chemicals. Two TLV standards are presented for each chemical. The Time Weighted Average (TWA) is the average chemical concentration in air, averaged over an 8-hour period, to which most workers can be exposed for an 8-hour day and 40-hour week for 50 years without any adverse health effects. The Short Term Exposure Limit (STEL) is a 15-minute time-weighted average exposure that should not be exceeded at any time during a work day even if the 8-hour time-weighted average is within the TLV. Also presented, when available, is the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL), and the NIOSH and OSHA Standards Completion Program (SCP) Immediately Dangerous to Life or Health (IDLH) level. The PEL values are presented either as an 8-hour TWA or a ceiling (Ceil) limit. The IDLH value represents a maximum concentration from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects. Other relevant health-based information that applies to this safety and health plan or to the employee's right to know is discussed under summary health reviews given below for those chemicals that may present significant risks.

TABLE A-2

INHALATION EXPOSURE LIMITS

CONTAMINANT	TLV-TWA	TLV-STEL	PEL	IDLH
The following limits are in units of parts per million (ppm)				
1,1-Dichloroethane	200	250	100	4000
1,2-Dichloroethane	10		50 100 Ceil 200 Peak	1000
Methylene Chloride	50		500 1000 Ceil 2000 5min/ 2-hr Peak	5000
1,1,1-Trichloroethane	350	450	350	1000
Toluene	100	150	200 3000 Ceil 500 10-min Peak	2000
Trichloroethylene	50	200	100 200 Ceil 300 Peak	1000
1,1-Dichloroethene vinylidene chloride (acrylonitrile polymer)	2		2 10 Ceil 15 min Peak	4000
trans-1,2 dichloroethene	50	200	200	4000
1,1,2-Trichloroethane	10		10	500
Carbon Tetrachloride	5		10 25 Ceil 200 5-min/ 4-hr Peak	300
Vinyl chloride	5		1 ppm 5 ppm 15-min. Ceil	
Tetrachloroethene	50	200	100 200 Ceil 300/5-min/ 3-hr. Peak	500

Chloroform	10		50 2ppm/60 min Ceil	1000
Benzene	10		10 50 ppm Ceil/ 10-min	2000
Phenol	5 Skin		5	100
Polychlorinated biphenyls	0.5 mg/m ³	.5mg/m ³	1mg/m ³	5mg/m ³

Toxicity summaries for these materials of concern are provided below:

METHYLENE CHLORIDE

(CH₂Cl₂, Dichloromethane, Methylene Dichloride)

Methylene Chloride is a solvent used mainly as a low temperature extractant of substances which are adversely affected by high temperature. It is also used as a paint remover and degreaser. Repeated contact with methylene chloride may cause a dry, scaly, and fissured dermatitis. The liquid and vapor are irritating to the eyes and upper respiratory tract at higher concentrations. If the liquid is held in contact with the skin, it may cause skin burns. Methylene chloride is a mild narcotic. Effects from intoxication include headache, giddiness, stupor, irritability, numbness, and tingling in the limbs. Irritation to the eyes and upper respiratory passages occurs at higher dosages. In severe cases, observers have noted toxic encephalopathy with hallucinations, pulmonary edema, coma, and death. Cardiac arrhythmias have been produced in animals but have not been common in human experiences. Exposure to this agent may cause elevated carboxyhemoglobin levels which may be significant in smokers, or workers with anemia or heart disease, and those exposed to CO. The ACGIH has listed methylene chloride as a suspected human carcinogen.

TLV: (proposed change)	50 ppm TWA (suspected human carcinogen)
PEL:	500 ppm TWA, 1000 ppm Ciel, 2000 ppm 5-min/2-hr peak
IDLH:	5000 PPM
DESCRIPTION:	Colorless liquid with a chloroform-like odor
SOLUBILITY:	1.3 %
FLASH POINT:	None
IONIZATION POTENTIAL:	11.35 eV
VAPOR PRESSURE:	350 mm Hg @ 20C
LEL:	N/A
UEL:	N/A
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	10 minutes at 1000 ppm (cartridge respirators are not recommended for this

material due to its poor warning properties)
HNu SENSITIVITY: 94 % with an 11.7 eV lamp
OVA SENSITIVITY: 90 %

1,1-DICHLOROETHYLENE

(1,1-Dichloroethene, 1,1-DCE, Vinylidene Chloride)

1,1-Dichloroethylene is a colorless volatile liquid with an ether-like, slightly acrid odor, similar to chloroform. The major routes of exposure are through inhalation and ingestion. 1,1-DCE is an experimental carcinogen and mutagen by skin contact, inhalation and other routes. It has toxicological properties similar to vinyl chloride. 1,1-Dichloroethylene is a severe irritant to skin, eyes and lungs, and can cause skin burns by rapid evaporation and consequent freezing. In high concentrations it acts as an anesthetic. Chronic exposure has shown liver injury, and circulatory and bone changes in the fingers have been reported in workers handling the material. It is an extreme fire hazard, and when heated to decomposition emits highly toxic fumes.

TLV:	5 ppm TWA, 20 ppm STEL
PEL:	N/A
IDLH:	N/A
DESCRIPTION:	Colorless liquid with a chloroform-like odor
SOLUBILITY:	N/A
FLASH POINT:	OF
IONIZATION POTENTIAL:	N/A
VAPOR PRESSURE:	N/A
LEL:	7.3 %
UEL:	16.0 %
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	N/A
HNu SENSITIVITY:	N/A
OVA SENSITIVITY:	40 %

1,1-DICHLOROETHANE

(CH_3CHCl_2 , Ethylidene dichloride, Ethylidene chloride, Assymetrical Dichloroethane)

1,1-Dichloroethane is a colorless liquid with an aromatic, ethereal odor and a hot saccharine taste. It is a solvent and is used in the plastics industry.

Ethylidene dichloride is an experimental teratogen and tumorigen, and shows moderate toxicity by ingestion. Liver damage has been reported in experimental animals. It is expected to affect the central nervous system, with symptoms of nausea, dizziness, headache and light-headedness. It is an extreme fire hazard, and emits toxic fumes upon thermal decomposition.

TLV:	200 ppm TWA, 250 ppm STEL
PEL:	100 ppm,
IDLH:	4000 ppm
DESCRIPTION:	Colorless liquid with a chloroform-like odor
SOLUBILITY:	0.35 to 0.63 %
FLASH POINT:	36 to 39F
IONIZATION POTENTIAL:	N/A
VAPOR PRESSURE:	180 to 265 mm Hg @ 20C
LEL:	9.7 %
UEL:	12.8 %
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	23 minutes at 1000 ppm
HNu SENSITIVITY:	129 % with an 11.7 eV lamp (1,2-dichloroethane)
OVA SENSITIVITY:	80 %

CHLOROFORM (CHCl₃, Trichloromethane, Methenyl chloride)

Chloroform is a clear, colorless liquid with a characteristic odor. It was one of the earliest general anesthetics, but its use for this purpose has been abandoned because of toxic effects. chloroform is widely used as a solvent, especially in the laquer industry. It is also used in the extraction and purification of penicillin and other pharmaceuticals, in the manufacture of artificial silk, plastics, floor polishes, and fluorocarbons, and also as a solvent in the semiconductor industry.

Chloroform may produce burns if left in contact with the skin. It is a relatively potent anesthetic at high concentrations. Death from its use as an anesthetic has resulted from liver damage and from cardiac arrest. Exposure may cause lassitude, digestive disturbance, dizziness, mental dullness and coma. Chronic overexposure has been shown to cause enlargement of the liver, and kidney damage. Alcoholics seem to be affected sooner and more severely from chloroform exposure. Disturbance to the liver is more characteristic of exposure than central nervous system depression or renal injury. There is some animal experimental evidence that suggests chloroform may be a carcinogen. The ACGIH has listed chloroform on its A2 carcinogen list, as a suspected human carcinogen.

TLV:	10 ppm TWA, A2 carcinogen
PEL:	50 ppm
IDLH:	1000 ppm
DESCRIPTION:	Colorless liquid with a pleasant, sweet odor
SOLUBILITY:	0.8 %
FLASH POINT:	None
IONIZATION POTENTIAL:	11.42 eV
VAPOR PRESSURE:	160 mm Hg @ 20C
LEL:	N/A
UEL:	N/A
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	33 minutes at 1000 ppm

HNu SENSITIVITY: 60 % with an 11.7 eV lamp
OVA SENSITIVITY: 65 %

1,2-DICHLOROETHANE

(ClCH₂CH₂Cl, Ethylene Dichloride, Sym-dichloroethane, Ethylene Chloride, Glycol Dichloride, Beta-dichloroethane)

1,2-Dichloroethane is a colorless, flammable liquid which has a pleasant odor and a sweetish taste. It is used widely in the manufacture of ethyl glycol, PVC, nylon, and other plastics. It is a solvent for resins, asphalt, bitumen, rubber and paint, and is used as a degreaser in the engineering, textile and petroleum industries. It is also used as an extracting agent for soya bean oil and caffeine, an antiknock agent in gasoline, a pickling agent, a fumigant, and a drycleaning agent.

Repeated contact with the liquid can produce a dry, scaly, fissured dermatitis. The liquid and vapor can also cause eye damage. Inhalation of high concentrations may cause nausea, vomiting, mental confusion, dizziness, and pulmonary edema. Chronic exposure has been associated with liver and kidney damage.

TLV: 10 ppm TWA
PEL: 50 ppm, 100 ppm Ceil, 200 ppm Peak
IDLH: 1000 ppm
DESCRIPTION: Clear liquid with a sweet odor like chloroform
SOLUBILITY: 0.8 %
FLASH POINT: 55F
IONIZATION POTENTIAL: 9.64 eV
VAPOR PRESSURE: 62 mm @ 20C
LEL: 6.2 %
UEL: 16 %
RESPIRATOR CARTRIDGE
BREAKTHROUGH TIME: 54 minutes at 1000 ppm
HNu SENSITIVITY: 129 % with an 11.7 eV lamp

OVA SENSITIVITY: 80 %

METHYL CHLOROFORM (CH_3CCl_3 , 1,1,1 - Trichloroethane)

Methyl chloroform, commonly known as 1,1,1 - trichloroethane, is a common solvent, used as a degreaser and cleaner for metals. Liquid and vapor are irritating to eyes on contact. This effect is usually noted first in acute exposure cases. Mild conjunctivitis may develop but recovery is usually rapid. Repeated skin contact may produce a dry, scaly, and fissured dermatitis, due to the solvent's defatting properties. Methyl chloroform is a narcotic and depresses the central nervous system. Acute exposure symptoms include dizziness, incoordination, drowsiness, increased reaction time, unconsciousness, and death.

TLV:	350 ppm TWA, 450 ppm STEL
PEL:	350 ppm
IDLH:	1000 ppm
DESCRIPTION:	Colorless liquid with a mild, chloroform-like odor
SOLUBILITY:	0.07 %
FLASH POINT:	NONE
IONIZATION POTENTIAL:	N/A
VAPOR PRESSURE:	100 mm Hg @ 20C
LEL:	7 %
UEL:	16 %
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	40 minutes at 1000 ppm
HNu SENSITIVITY:	90 % with an 11.7 eV lamp
OVA SENSITIVITY:	105 %

CARBON TETRACHLORIDE (Tetrachloroethane, Perchloromethane)

Carbon tetrachloride is a colorless, nonflammable liquid with a characteristic odor. It can be used as a solvent for oils, fats, lacquers, varnishes, rubber, waxes and resins. Fluorocarbons are

chemically synthesized from it. It is also used as an azeotropic drying agent for spark plugs and as a fumigant. Its use in applications other than in the chemical industry is negligible, due to its carcinogenic status. It is listed as a suspected human carcinogen by the ACGIH.

Carbon tetrachloride removes the natural lipid cover of the skin. Repeated contact may lead to a dry, scaly, fissured dermatitis. Eye contact is slightly irritating, but this condition is transient. Excessive exposure may result in central nervous system depression, and gastrointestinal symptoms may also occur. Following acute exposure, signs and symptoms of liver and kidney damage may develop, such as nausea, vomiting, abdominal pain, diarrhea, enlarged and tender liver, and jaundice resulting from toxic hepatitis. Diminished urinary volume, red and white blood cells in the urine, albuminuria, coma, and death may be consequences of acute renal failure. The hazard of systemic effects is increased when carbon tetrachloride is used in conjunction with ingested alcohol.

TLV:	5 ppm TWA, Skin, A2 carcinogen
PEL:	10 ppm, 25 ppm Ceil, 200 ppm 5-min/4-hr Peak
IDLH:	300 ppm
DESCRIPTION:	Colorless liquid with an ether-like odor
SOLUBILITY:	0.08 %
FLASH POINT:	None
IONIZATION POTENTIAL:	11.47 eV
VAPOR PRESSURE:	91 mm Hg @ 20C
LEL:	N/A
UEL:	N/A
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	77 minutes at 1000 ppm
HNu SENSITIVITY:	90 % with an 11.7 eV lamp
OVA SENSITIVITY:	10 %

TRICHLOROETHYLENE

(CHClCCl_2 , Ethylene Trichloride, Ethinyl Trichloride, Trichloroethene, TCE)

Trichloroethylene is a colorless, nonflammable, non-corrosive liquid with the "sweet" odor characteristic of some chlorinated hydrocarbons. Decomposition of trichloroethylene, due to contact with hot metal or ultraviolet radiation, forms products including chlorine gas, hydrogen chloride, and phosgene. Dichloroacetylene may be formed from the reaction of alkali with trichloroethylene. TCE is primarily used as a solvent in vapor degreasing. It is also used for extracting caffeine from coffee, as a drycleaning agent, and as a chemical intermediate in the production of pesticides, waxes, gums, resins, tars, paints, varnishes, and specific chemicals such as chloroacetic acid.

Exposure to trichloroethylene vapor may cause irritation of the eyes, nose, and throat. The liquid, if splashed in the eyes, may cause burning irritation and damage. Repeated or prolonged skin contact with the liquid may cause dermatitis. Acute exposure to trichloroethylene depresses the central nervous system exhibiting such symptoms as headache, dizziness, vertigo, tremors, nausea and vomiting, irregular heart beat, sleepiness, fatigue, blurred vision, and intoxication similar to that of alcohol. Unconsciousness and death have been reported. Alcohol may make the symptoms of trichloroethylene overexposure worse. If alcohol has been consumed, the overexposed worker may become flushed. TCE addiction and peripheral neuropathy have been reported. Recent reports indicate that exposure to trichloroethylene may induce liver tumors in mice.

TLV:	50 ppm TWA, 200 ppm STEL
PEL:	100 ppm, 200 ppm Ceil, 300 ppm Peak
IDLH:	1000 ppm
DESCRIPTION:	Colorless liquid with a chloroform-like odor
SOLUBILITY:	0.1 %
FLASH POINT:	None

IONIZATION POTENTIAL: 9.47 eV
VAPOR PRESSURE: 58 mm Hg @ 20C
LEL: 11 %
UEL: 41 %
RESPIRATOR CARTRIDGE
BREAKTHROUGH TIME: 55 minutes at 1000 ppm
HNU SENSITIVITY: 89 % with a 10.2 eV lamp
OVA SENSITIVITY: 70 %

TOLUENE

(C₆H₅CH₃, Toluol, methylbenzene, phenylmethane, methylbenzol)

Toluene is a clear, colorless, noncorrosive liquid with a sweet, pungent, benzene-like odor. It may be encountered in the manufacture of benzene, and it is also used as a chemical feed stock for toluene diisocyanate, phenol, benzyl and benzyl derivatives, benzoic acid, toluene sulfonates, nitrotoluenes, vinyl toluene, and saccharin, and as a solvent for paints and coatings, or as a component of automobile and aviation fuels.

Toluene may cause irritation of the eyes, respiratory tract, and skin. Repeated or prolonged contact with the liquid may cause removal of natural lipids from the skin, resulting in dry, fissured dermatitis. The liquid splashed in the eyes may cause irritation and reversible damage. Acute exposure to toluene predominantly results in central nervous system depression. Symptoms and signs include headache, dizziness, fatigue, muscular weakness, drowsiness, incoordination with staggering gait, skin paresthesias, collapse, and coma.

TLV: 100 ppm TWA, 150 ppm STEL
PEL: 200 ppm TWA, 300 ppm Ceil, 500 ppm 10-min Peak
IDLH: 2000 PPM
DESCRIPTION: Colorless liquid with an aromatic odor like benzene

SOLUBILITY:	0.05 %
FLASH POINT:	40F
IONIZATION POTENTIAL:	8.82 eV
VAPOR PRESSURE:	22 mm Hg @ 20C
LEL:	1.3 %
UEL:	7.1 %
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	94 minutes at 1000 ppm
HNu SENSITIVITY:	100 % with a 10.2 eV lamp
OVA SENSITIVITY:	110 %

PERCHLOROETHYLENE

(CCl₂CCl₂, Tetrachloroethylene, Carbon Dichloride, Ethylene Tetrachloride)

Perchloroethylene is a widely used solvent with particular use as a drycleaning agent and a degreaser. Repeated contact with the liquid may cause a dry, scaly, and fissured dermatitis. High concentrations may produce eye and nose irritation. Acute exposure to tetrachloroethylene may cause central nervous system depression, hepatic injury, and anesthetic death. Cardiac arrhythmias and renal injury have been produced in animal experiments. Signs and symptoms of overexposure include malaise, dizziness, headache, increased perspiration, fatigue, staggering gait, and slowing of mental ability. These usually subside quickly upon removal into the open air.

TLV:	50 ppm TWA, 200 ppm STEL
PEL:	100 ppm, 200 ppm Ceil, 300 ppm 5-min/3-hr Peak
IDLH:	500 ppm
DESCRIPTION:	Colorless liquid with an odor like ether or chloroform
SOLUBILITY:	0.015%
FLASH POINT:	N/A
IONIZATION POTENTIAL:	9.32 eV

VAPOR PRESSURE:	14 mm Hg
LEL:	N/A
UEL:	N/A
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	107 minutes at 1000 ppm
HNu SENSITIVITY:	N/A
OVA SENSITIVITY:	70 %

PHENOL (C₆H₅OH)

Phenol is commonly used in the semi-conductor industry as a component in the formation of plastics and resins. Phenol has a marked corrosive effect on any tissue. When it comes in contact with the eyes it may cause severe damage and blindness. On contact with the skin, it does not cause pain but causes a whitening of the exposed area. If the chemical is not removed promptly, it may cause a severe burn or systemic poisoning. Systemic effects may occur from any route of exposure. These include paleness, weakness, sweating, headache, ringing of the ears, shock, cyanosis, excitement, frothing of the nose and mouth, dark colored urine, and death. If death does not occur, kidney damage may appear. Repeated or prolonged exposure to phenol may cause chronic phenol poisoning. This condition is very rarely reported. The symptoms of chronic poisoning include vomiting, difficulty in swallowing, diarrhea, lack of appetite, headache, fainting, dizziness, dark urine, mental disturbances, and possibly, skin rash. Liver and kidney damage and discoloration of the skin may occur.

TLV:	5 ppm TWA Skin
PEL:	5 ppm
IDLH:	100 ppm
DESCRIPTION:	Colorless to pink solid or thick liquid with a characteristic sweet, tarry odor
SOLUBILITY:	8.4 %
FLASH POINT:	174 DEG. F

IONIZATION POTENTIAL:	8.5 eV
VAPOR PRESSURE:	0.36 mm Hg @ 20C
LEL:	1.7 %
UEL:	8.6 %
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	N/A
HNu SENSITIVITY:	77 % with a 9.5 eV lamp
OVA SENSITIVITY:	N/A

1,2-DICHLOROETHYLENE

(Acetylene dichloride, sym-dichloroethylene, 1,2-dichloroethene.)

ClCH=CHCl , 1,2-dichloroethylene, exists in two isomers, cis 60% and trans 40%. There are variations in toxicity between these two forms. At room temperature, it is a liquid with a slight acrid, ethereal odor. Gradual decomposition results in hydrochloric acid formation in the presence of ultraviolet light or upon contact with hot metal. 1,2-Dichloroethylene is used as a solvent for waxes, resins, and acetyl cellulose. It is also used in the extraction of rubber, as a refrigerant, in the manufacture of pharmaceuticals and artificial pearls, and in the extraction of oils and fats from fish and meat.

1,2-Dichloroethylene acts principally as a narcotic, causing central nervous system depression. Symptoms of acute exposure include dizziness, nausea and frequent vomiting, and central nervous system intoxication similar to that caused by alcohol. Renal effects, when they do occur, are transient.

TLV:	200 ppm
PEL:	200 ppm
IDLH:	4000 ppm
DESCRIPTION:	Colorless liquid with an ether-like, slightly acrid odor, like chloroform
SOLUBILITY:	0.35 TO 0.63%
FLASH POINT:	36 to 37° F

IONIZATION POTENTIAL:	9.66 eV
VAPOR PRESSURE:	180 to 265 mm Hg @ 20°C
LEL:	9.7%
UEL:	12.8%
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	33 minutes at 1000 ppm
HNu SENSITIVITY:	N/A
OVA SENSITIVITY:	50%

VINYL CHLORIDE

(Chloroethylene, chloroethene, monochloroethylene.)

$\text{CH}_2=\text{CHCl}$, vinyl chloride, is a flammable gas at room temperature and is usually encountered as a cooled liquid. The colorless liquid forms a vapor which has a pleasant ethereal odor. Vinyl chloride is used as a vinyl monomer in the manufacture of polyvinyl chloride and other resins. It is also used as a chemical intermediate and as a solvent.

Vinyl chloride is a skin irritant, and contact with the liquid may cause frostbite upon evaporation. The eyes may be immediately and severely irritated. Vinyl chloride depresses the central nervous system causing symptoms which resemble mild alcohol intoxication. Lightheadedness, some nausea, and dulling of visual and auditory responses may develop in acute exposures. Death from severe vinyl chloride exposure has been reported. Chronic exposure of workers involved in reactor vessel entry and hand cleaning may result in the triad of acro-osteolysis, Raynaud's phenomenon, and sclerodermatous skin changes. Chronic exposure also may cause hepatic damage. Vinyl chloride is regarded as a human carcinogen, and a causal agent of angiosarcoma of the liver. Excess cancer of the lung and the lymphatic and nervous systems also has been reported. Experimental evidence of tumor induction in a variety of organs, including liver, lung, brain, and kidney, as well as nonmalignant alterations, such as fibrosis and connective tissue deterioration, indicate the multisystem oncogenic and toxicologic effects of vinyl chloride.

TLV:	5ppm
PEL:	1ppm
IDLH:	
DESCRIPTION:	Colorless gas, liquifies in a freezing mixture
SOLUBILITY:	Slight
FLASH POINT:	-108°F
IONIZATION POTENTIAL:	9.995 eV
VAPOR PRESSURE:	2580 mm Hg @ 20°C
LEL:	3.6%
UEL:	33%
RESPIRATORY CARTRIDGE	
BREAKTHROUGH TIME:	3.8 minutes at 1,000 ppm
HNu SENSITIVITY:	50% with a 10.2 eV lamp
OVA SENSITIVITY:	35%

CHLORODIPHENYLS AND DERIVATIVES

(Chlorobiphenyls, polychlorinated biphenyl, PCB.)

$C_{12}H_{10-x}Cl_x$, Chlorodiphenyls, are diphenyl rings in which one or more hydrogen atoms are replaced by a chlorine atom. Most widely used are chlorodiphenyl (42% chlorine), containing 3 chlorine atoms in unassigned positions, and chlorodiphenyl (54% chlorine) containing 5 chlorine atoms in unassigned positions. These compounds are light, straw-colored liquids with typical chlorinated aromatic odors; 42% chlorodiphenyl is a mobile liquid and 54% chlorodiphenyl is a viscous liquid. Chlorinated diphenyl oxides are ethers of chlorodiphenyls and are included in this group. They range from clear, oily liquids to white to yellowish waxy solids, depending on the degree of chlorination. Chlorinated diphenyls are used alone and in combination with chlorinated naphthalenes. They are stable, thermoplastic, and non-flammable, and find chief use in insulation for electric cables and wires in the production of electric condensers, as additives for extreme pressure lubricants, and as a coating in foundry use.

Prolonged skin contact with PCB fumes or cold wax may cause the formation of comedones, sebaceous cysts, and pustules, known as chloracne. Irritation to eyes, nose, and throat also may occur. The above standards are considered low enough to prevent systemic effects, but it is not known whether or not these levels will prevent local effects. Generally, toxic effects are dependent upon the degree of chlorination; the higher the degree of substitution, the stronger the effects. Acute and chronic exposure can cause liver damage. Signs and symptoms include edema, jaundice, vomiting, anorexia, nausea, abdominal pains, and fatigue. Studies of accidental oral intake indicate that chlorinated diphenyls are embryotoxic, causing stillbirth, a characteristic grey-brown skin, and increased eye discharge in infants born to women exposed during pregnancy. PCBs are characterized as probable human carcinogens.

TLV:	0.5 mg/m ³
PEL:	0.5 mg/m ³
IDLH:	5 mg/m ³
DESCRIPTION:	Varies according to % of chlorine
SOLUBILITY:	Insoluble
FLASH POINT:	349° to 432° F
VAPOR PRESSURE:	.00006 - .001 mg Hg @ 20C
RESPIRATOR CARTRIDGE	
BREAKTHROUGH TIME:	N/A
HNu SENSITIVITY	N/A
OVA SENSITIVITY	N/A

1,1,2-TRICHLOROETHANE

(Vinyl trichloride)

CH₂ClCHCl₂, 1,1,2-trichloroethane, is a colorless, nonflammable liquid. It is an isomer of 1,1,1-trichloroethane but should not be confused with it toxicologically. 1,1,2-Trichloroethane is comparable to carbon

tetrachloride and tetrachloroethane in toxicity. 1,1,2-Trichloroethane is used as a chemical intermediate and as a solvent, but is not as widely used as its isomer, 1,1,1-trichloroethane.

Little is known of the toxicity of 1,1,2-trichloroethane to humans. Animal experiments show 1,1,2-trichloroethane to be a potent central nervous system depressant. The injection of anesthetic doses in animals was associated with both liver and renal neurosis. It is characterized as a possible human carcinogen based upon limited evidence in animal studies.

TLV:	10 ppm SKIN
PEL:	10 ppm
IDLH:	500 ppm
DESCRIPTION:	Colorless liquid with a sweet odor like chloroform
SOLUBILITY:	0.5%
FLASH POINT:	None
VAPOR PRESSURE:	19 mm Hg @ 20C
LEL:	6%
UEL	15.5%
RESPIRATORY CARTRIDGE	
BREAKTHROUGH TIME:	72 minutes at 1000 ppm

BENZENE

(Benzol, phenyl hydride, coal naphtha, phene, benxole, cyclohexatriene.)

C_6H_6 , benzene, is a clear, volatile, colorless, highly flammable liquid with a characteristic odor. The most common commercial grade contains 50-100% benzene, the remainder consisting of toluene, xylene, and other constituents which distill below 120°C. Benzene is used as a constituent in motor fuels, as a solvent for fats, inks, oils, paints, plastics, and rubber, in the extraction of oils from seeds and nuts, and in photogravure printing. It is also used as a chemical

intermediate. By alkylation, chlorination, nitration, and sulfonation, chemicals such as styrene, phenols, and maleic anhydride are produced. Benzene is also used in the manufacture of detergents, explosives, pharmaceuticals, and dyestuffs.

Exposure to liquid and vapor may produce primary irritation to skin, eyes, and upper respiratory tract. If the liquid is aspirated into the lung, it may cause pulmonary edema and hemorrhage. Erythema, vesiculation, and dry, scaly dermatitis also may develop from defatting of the skin. Acute exposure to benzene results in central nervous system depression, headache, dizziness, nausea, convulsions, coma, and death may result. Death has occurred from large acute exposure as a result of ventricular fibrillation, probably caused by myocardial sensitization to endogenous epinephrine. Early reported autopsies revealed hemorrhages (non-pathognomonic) in the brain, pericardium, urinary tract, mucous membranes, and skin. Chronic exposure to benzene is well documented to cause blood changes. Benzene is basically a myelotoxic agent. Erythrocyte, leukocyte, and thrombocyte counts may first increase, and then aplastic anemia may develop with anemia, leukopenia, and thrombocytopenia. The bone marrow may become hypo- or hyper-active and may not always correlate with peripheral blood. Recent epidemiologic studies along with case reports of benzene related blood dyscrasias and chromosomal aberrations have led NIOSH to conclude that benzene is leukemogenic. The USEPA also characterizes benzene as a human carcinogen. The evidence is most convincing for acute myelogenous leukemia and for acute erythroleukemia, but a connection with chronic leukemia has been noted by a few investigators. Recent work has shown increases in the rate of chromosomal aberrations associated with benzene myelotoxicity. These changes in the bone marrow are stable or unstable and may occur several years after exposure has ceased. "Stable" changes may give rise to leukemic clones and seem to involve chromosomes of the G group.

TLV:	10 ppm
PEL:	10 ppm
IDLH:	2,000
DESCRIPTION:	Colorless liquid with an aromatic odor
SOLUBILITY:	0.18%
FLASH POINT:	12 degrees F
IONIZATION POTENTIAL:	9.25 eV
VAPOR PRESSURE:	75 mm Hg @ 20 degrees C
LEL:	1.3%
UEL:	7.1%
RESPIRATORY CARTRIDGE	
BREAKTHROUGH TIME:	73.3 minutes at 1,000 ppm
HNu SENSITIVITY:	100% with an 10.2 eV lamp
OVA SENSITIVITY:	150%

5.0 QUALITATIVE RISK ANALYSIS

The principal potential hazard associated with drilling operations at this site is exposure to organic liquids and vapors. The likelihood of over exposure to any of these compounds at this site is slight. However, due to the toxicity, the possible carcinogenic affects, and the various routes of entry into the body, appropriate monitoring and personal protective equipment will be used to reduce the risks.

Heavy metals have also been detected at this site, and could pose a threat to human health via inhalation and ingestion of contaminated soil particles. If substantial airborne dust becomes evident, a half mask respirator with combination cartridges will be required. These requirements will be identified under Section 7, Required Personal Protective Equipment.

6.0 ENVIRONMENTAL MONITORING

Organic vapor readings will be made with an OVA at each well sampling at the time the well is opened or upon coming to the well location in the case of open wells. If a newly opened well has an excessively high reading (as defined in Table 7.1), the sampling personnel shall leave the site for 10 minutes and then return for a definitive reading. This second reading and subsequent readings will be used to trigger the use of additional personal protective equipment (PPE) if warranted. An additional reading will be taken during each well sampling at the time the first water sample is removed. During soil sample boring operations, organic vapor readings will be taken when the first soil cuttings are brought to the surface, when the augers are disconnected from the drive cap and when the split spoon sampler is opened to remove sample. If vapor concentrations in the breathing zone exceed acceptable limits, appropriate respirators will be donned.

At all well installations, organic vapor readings will be made during all core barrel removal, drill pipe disconnection, and all initial sample inspection, pumping and/or bailing operations at each new depth. All organic vapor readings will be recorded in the field log and copies delivered to the SEC Health and Safety Director.

7.0 REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Respiratory Protection

Due to previous sample results observed at this site, level C or a modified level D (tyvek suits, boots, gloves) must be maintained throughout the duration of the work in the exclusion zone. Respiratory protection requirements will be in accordance with Table 7.1.

TABLE 7.1 RESPIRATORY PROTECTION REQUIREMENTS

<u>Stage</u>	<u>OVA Reading</u>	<u>Response</u>		
				If detector tube reading is ≥ 2 ppm, a respirator is required
1	2 ppm continuous 5 ppm for a 15 min. period	Put on a half face respirator with HEPA/Organic vapor combination cartridges	<u>or</u> Take a grab sample using Sensidyne detector tube 131LA (Vinyl Chloride-low range)	If detector tube reading is < 2 ppm, proceed to stage 2 or 3.
2	10 ppm continuous 50 ppm for a 15 min. period	Put on a half face respirator with HEPA/Organic vapor combination cartridges		
3	100 ppm	Evacuate site, and notify SEC Health and Safety Director for further instructions.		

b. Nonrespiratory Personal Protective Equipment

The following items will be required for field operations at this site:

- Hardhat
- Neoprene or Nitrile Steel Toe Boots
- Nitrile Gloves
- Tyvek Suits
- Safety Glasses or Goggles for work around drill equipment
- Eyewash (15 minute)
- Fire Extinguisher (20 lb. ABC)
- First Aid Kit
- Decontamination Sprayer and Decon Solution
- 5 Gallon Cooler with Gatorade
- 5 Gallon Wash Water Container (for washing hands and face)

PPE SUMMARY

<u>OPERATION</u>	<u>PPE REQUIRED IN THE EXCLUSION ZONE</u>
Soil Gas Survey	Subcontracted
Test Pit Excavation	Neoprene or nitrile steel toe boots, Tyvek suits, nitrile gloves, hard hat, 1/2 mask respirators with combination organic vapor/HEPA filter cartridges. (If monitoring indicates need.)
Well Installation	Neoprene or nitrile steel toe boots, Tyvek suits, nitrile gloves, hard hat, 1/2 mask respirator with organic vapor cartridges. (Combination cartridges are acceptable.)
Ground Water Sampling	Neoprene or nitrile steel toe boots, Tyvek suits, nitrile gloves.

Slug Tests

Neoprene or nitrile steel toe boots, nitrile gloves, Tyvek suits if the potential for liquid splash exists.

Soil Borings

Neoprene or nitrile steel toe boots, Tyvek suits nitrile gloves. Respirators may be needed if organic vapors are detected.

Surface water and Sediment Sampling

Neoprene or nitrile steel toe boots, nitrile gloves.

Pump Test

Neoprene or nitrile steel toe boots, Tyvek suit, nitrile gloves, respirators if necessary.

8.0 HEAT/COLD STRESS PROTECTIVE MEASURES

Heat and cold stress are not expected to be a problem as this project is expected to begin in mid-Fall and be completed before Winter begins. However, plenty of cold drinking water will be provided on warm days. On cold days, additional personal clothing may be worn under the Tyvek coveralls and cloth gloves under the rubber gloves. The protection from getting wet and wind barrier provided by the Tyvek coveralls, rubber gloves and boots should provide adequate protection from the lowest temperatures expected at this time of year.

9.0 ACCIDENT PREVENTION

Preventing accidents is the responsibility of each individual on site. Unsafe or dangerous working conditions shall be reported immediately to the Site Health and Safety Officer (HSO).

Instructing respective employees in safe work practices and emergency procedures is the responsibility of the contractor and subcontractor(s). SEC shall provide the subcontractor(s) with the

Health and Safety Plan, for information only. Adherence to the standard safety operating procedures and practices described below shall be required of SEC personnel to minimize the risk of accidents resulting in injury or excessive chemical exposure.

10.0 STANDARD OPERATING SAFETY PROCEDURES AND CONTROLS

The following general operating procedures shall be followed by all site personnel. These precautionary measures are designed to reduce the risks of inadvertent or accidental chemical exposure or injury during on-site operations.

Personal Precautions

- o Be familiar with standard operating safety procedures and adhere to all instructions and requirements in the site safety plan.
- o Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any contaminated or potentially contaminated area. However, a supply of cold water and disposable cups will be located in the decontamination area such that employees will have access to water with only removal of gloves, hat, and respirator where used.
- o Contact lenses shall not be worn in any contaminated area.
- o Hands and face must be thoroughly washed upon leaving the work area. Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
- o No facial hair which interferes with a satisfactory respirator fit of the mask-to-face-seal is allowed on personnel required to wear respirators.

- o Avoid contact with contaminated or suspected contaminated surfaces. Whenever possible, avoid walking through puddles, pools, mud, etc. Avoid kneeling or sitting on the ground, equipment or drums.
- o Personal articles shall be prohibited in any contaminated area.
- o Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Alcoholic beverage intake should be minimized or avoided on off work hours during field operations. Prescribed drugs should not be taken by personnel on site operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Do not work when ill.
- o Be alert to potential health and safety hazards.

Operational Requirements

- o All personnel going on-site shall be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications.
- o Respiratory protective devices and/or protective clothing appropriate to the designated levels of protection shall be worn by all personnel going into areas designated for wearing protective equipment. (See Section 7)
- o Personnel on-site shall use the buddy system when wearing respiratory protective equipment.
- o Visual and/or voice contact shall be maintained between pairs

on-site. Entry team members shall remain close together to assist each other during emergencies.

- o During continual operations, on-site workers shall act as safety backup to each other. Off-site personnel shall provide emergency assistance.
- o Personnel should practice unfamiliar operations prior to doing the actual procedure.
- o Entrance and exit locations shall be designated and emergency escape routes delineated. The following warning signals shall be used when necessary:

Hand gripping throat -----	Can't breathe
Grip partner's wrist or	
both hands at waist -----	Leave area immediately
Hands on top of head -----	Need assistance
Thumbs up -----	OK, I am all right, I
	understand
Thumbs down -----	No, negative

- o Communications shall be maintained between field team members at all times. The nearest telephone to site activities will be located in order to facilitate emergency response communications.
- o Wind indicators visible from the work location should be identified before commencing operations.
- o Personnel and equipment in the contaminated area shall be minimized, consistent with effective site operations.
- o Decontamination procedures for leaving a contaminated area shall be followed. Hands and face shall be washed prior to work breaks and eating. Work areas and decontamination procedures have been

established based on expected site conditions (See Section 11).

- o Report all injuries or work related illnesses to the site HSO or supervisor as soon as possible.

Drilling Safety

Drilling safety is the responsibility of each member of the drilling crew. Standard operating safety procedures shall comply with guidelines/recommendations specified in the Drilling Safety Guide (National Drilling Federation) or the Manual of Recommended Safe Operating Procedures and Guidelines for Water Well Contractors and Pump Installers (National Water Well Association) or other recognized drilling industry safety guidelines.

SEC personnel shall not assist subcontracted drillers with their assigned tasks. This is required in order to limit the exposure of SEC employees to hazards associated with drilling operations.

Although SEC is not required to provide safety oversight for drillers, the drilling supervisor should be informed of any safety violations, unsafe work practices or imminent danger observed by SEC in the normal performance of our assigned duties.

Adherence to Buddy System

No field operation is without some degree of risk. For this reason, a minimum of two people must be assigned to all task locations and must stay within voice contact at all times.

11.0 DECONTAMINATION CONTROL MEASURES

Site work zones shall be established to reduce the accidental spread of hazardous substances by workers or equipment. The flow of personnel and equipment among these zones shall be controlled through

designated access and egress points by the Site Health and Safety Officer (HSO).

Site Organization and Control

Site organization and control will be established and maintained according to the recommendations set forth in EPA's "Standard Operating Safety Guide," November 1984, and the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," October 1985. Three general areas of operation shall be established to reduce the risk of personnel exposure to hazardous substances. The three areas are:

- o Exclusion Zone (Zone A)
- o Contamination Reduction Zone (Zone B)
- o Support Zone (Zone C)

The dimensions of each area and the safe working distances between each area shall be balanced against practical work considerations and existing field conditions.

Exclusion Zone

The Exclusion Zone shall consist of the entire work site until further delineation is made by the HSO. Since this area shall be considered contaminated, all personnel within the area must use the prescribed levels of personal protection. A checkpoint shall be established at the periphery of the Exclusion Zone to regulate the flow of personnel and equipment in and out of the area. The initial Exclusion Zone boundary (hotline) is based upon the actual presence of wastes or spilled materials. The boundary shall be readjusted based on subsequent observations and/or measurements. Any change in the protection level specified by the original HSP shall be approved by the SEC Health and Safety Director (HSD) and the SRP Contracting Officer before being initiated. The hotline shall be well-defined by

geographical or physical boundaries and shall be physically secure.

Where the use of respiratory protection is not required during normal work activities, respirators should be immediately available for use should a potential hazard become evident.

Any item taken into the Exclusion Zone shall be considered to be contaminated until carefully inspected by the site HSO and/or decontaminated. All vehicles, equipment, instruments, and materials taken into the Exclusion Zone shall remain in the zone until decontaminated.

Contamination Reduction Zone

The Contamination Reduction Zone (Zone B) will surround Zone A. This zone shall serve as a buffer between the Exclusion Zone and the Support Zone, and is intended to prevent the spread of contaminants from work areas. All decontamination procedures shall be conducted within this area, along a defined corridor.

The boundary between the Support Zone and Contamination Reduction Zone is the contamination control line. This boundary separates the area of possible contamination from clean areas. Entry into Contamination Reduction Zone from the Support Zone will be through a controlled access point. Personnel entering this area shall be wearing the prescribed personal protective equipment. Exit from the Contamination Reduction Zone requires the removal of any suspected or known contaminants through compliance with established decontamination procedures.

Support Zone

The Support Zone (Zone C) shall consist of a staging area in a non-contaminated or clean area. It shall contain the command post for field operations, a first aid station, and other elements necessary to support site activities. Normal work clothes and safety shoes are worn

in this area. Location of access points and the command post shall be based upon wind direction, topography and site accessibility. Preferably, the command post should be located upwind of the site Exclusion Zone. However, wind direction shift and other conditions may be such that the ideal location based upon wind direction does not exist. The terrain, i.e., woods, water or hills, and available space may limit selection of command post sites.

Modifications to Site Control

The use of the three-area designation with access/egress control points coupled with established decontamination procedures provides reasonable assurance against the translocation of contaminants. This system of control is based on a "worst case" situation.

Less stringent site control and decontamination procedures may be utilized based upon field activities and results of monitoring data. Any modification must be approved by the SEC HSD and documented in an amendment to this Health and Safety Plan.

Decontamination Procedures

Safe personal hygiene practices are discussed in Section 10, Standard Operating Safety Procedures and Controls. Decontamination shall be performed under the supervision of the HSO. Personnel and portable field equipment decontamination shall be carried out in the contamination reduction corridor. When working in the Exclusion Zone, care should be taken to avoid contamination of equipment (particularly instruments) whenever possible. Drill rigs, other heavy equipment and ancillary tools will be cleaned at the heavy equipment decontamination area within the Exclusion Zone and adjacent to the Hotline. Critical zones and areas shall be variously identified and delineated with surveyor's tape.

For all egress from the Exclusion Zone, decontamination stations shall consist of:

- o Equipment drop
- o Boot and glove wash
- o Boot and glove rinse
- o Tyvek disposal (into 55-gallon drum or other suitable container)
- o Respirator wash and rinse (only when conditions mandate respirator use)
- o Hand and face wash and rinse

NOTE: All persons subject to decontamination should shower daily as soon as practicable after their work shift. Decontamination procedures will be reviewed for each project phase. All revisions will be included in an amendment to this document.

Monitoring instruments and protective equipment shall be decontaminated if the equipment has been in contact with the ground or splashed with contaminated water, mud or other material. Decontamination solution shall consist of detergent and water. Rinse solution shall be potable water. Decontamination and rinse solutions shall be disposed on site under the supervision of the HSO.

Decontamination of drill rigs, vehicles, equipment and ancillary tools and sampling devices shall consist of removal of contaminated soil and mud, and steam cleaning. All vehicles and equipment shall be cleaned before relocation to and use at any other sampling site or work area.

Medical Emergencies

For physical injuries, first aid treatment shall be given at the site, depending upon the seriousness of the injury. The victim should undergo decontamination, if necessary, unless such procedures interfere with necessary treatment. In life-threatening situations care shall be instituted immediately. Always remove respirators. Protective clothing shall be removed or cut away if this will not cause delays, interfere with treatment, or aggravate the problem. If contaminated protective clothing cannot be removed, wrap the victim in clean materials to help prevent contamination of medical personnel and ambulances.

For chemical exposure emergencies, decontamination procedures shall be followed unless severe medical problems requiring life sustaining measures are evident.

12.0 EMERGENCY EQUIPMENT

Emergency equipment available on-site shall include:

- o First Aid Kits, (16 unit as specified in National Safety Council Data Sheet No. 202 or equivalent),
- o Portable Eyewash (15 minute duration)
- o Half-mask Respirators - HEPA/Organic Vapor Combination Cartridges (GMA-H or GMC-H),
- o Citizens' Band (CB) Radio (if field conditions warrant),
- o Fire Extinguisher.

First Aid

In the event of injury, the emergency shall be handled according to the procedures described in the Emergency Procedures Section. The first aid kits shall be maintained at the control access point between the decontamination and support zones and in support vehicles.

If the victim cannot be safely moved from the contamination area, first aid necessary to stabilize the victim for safe transport shall be administered at the accident location. Appropriate decontamination of all clothing and equipment shall be followed upon leaving the contaminated area.

13.0 EMERGENCY PROCEDURES

Some risk of personal injury or chemical exposure is inherent in hazardous waste site activities. These risks and the effects of unpredictable events such as injury, chemical exposure, fire or explosion shall be minimized by:

- o Adhering to good work practices,
- o Using personal protective equipment appropriate for existing field conditions,
- o Performing adequate monitoring of individuals and ambient field conditions,
- o Staying alert both to personal performance and to that of co-workers.

An emergency situation is considered to exist if:

- o Any member of the field crew is injured in an accident,

- o Any member of the field crew experiences or exhibits any adverse effects or symptoms of chemical exposure,
- o Safety monitoring indicates site conditions more hazardous than anticipated or that an immediate danger to life or health exists.

General Emergency Procedures

- o In the event that any member of the field crew experiences any adverse effects or symptoms of exposure while on the scene, the entire field crew shall immediately halt work and act according to the instructions provided by the HSO.
- o The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated, shall result in the evacuation of the field team and re-evaluation of the hazard and the level of protection required.
- o In the event that any member of the field crew experiences any adverse effects or symptoms of exposure while on the site, the entire field crew shall immediately halt work and act according to the instructions provided by the site HSO. The HSO then shall complete an Accident Report. Follow-up action shall be taken to correct the situation that caused the accident.

Personal Injury

Site personnel are trained in American Red Cross first aid procedures and shall administer appropriate first aid treatment, including CPR, in emergency situations. The following general emergency procedures shall be carried out in the event of injury:

- (1) Notify the HSO of the incident.
- (2) If the victim can be moved safely, remove from the contaminated

zone to the decontamination zone using established control points.

- (3) Administer first aid.
- (4) Transport victim to nearest hospital or emergency medical center or call for ambulance transport, as appropriate.

NOTE: The HSO shall direct the removal of injured personnel from the contaminated zone and shall approve any necessary deviation from established decontamination procedures. Such deviation shall be based upon the severity or life threatening nature of the injury.

- (5) Notify the HSD of the incident and describe the emergency response actions taken.

Chemical Exposure

Before entering the contaminated zone, all site personnel shall be thoroughly acquainted with the types of toxic/hazardous chemicals present on site and their potential concentrations. The following general procedures shall be followed for chemical exposure emergencies:

- (1) Move the victim from the immediate area of exposure/contamination, taking precautions to prevent additional exposure of other individuals.
- (2) Notify the HSO of the exposure incident.
- (3) If victim can be moved safely, proceed to the decontamination zone through established control points.
- (4) Decontaminate clothing or remove if safe to do so.

- o For skin or eye contact, thoroughly wash affected areas with water (eyes should be flushed for at least 15 minutes).
 - o For inhalation exposure, ensure that victim has adequate fresh air.
- (5) Administer additional first aid treatment as appropriate.
 - (6) Transport victim to nearest hospital or emergency medical center or call for ambulance transport as appropriate.

NOTE: The site HSO shall direct the removal of injured personnel from the contaminated zone and shall approve any necessary deviation from established decontamination procedures. Such deviation shall be based upon the security or life threatening nature of the injury.

- (7) Notify the HSD of the incident and describe the emergency response actions taken.

Fire or Explosion

In the event of a fire or explosion:

- (1) Immediately evacuate injured personnel and leave the area
- (2) Administer first aid as appropriate
- (3) Notify emergency services
- (4) Notify the HSD

Emergency Contacts

The appropriate contact(s) from the following list shall be made for all emergency situations.

Gaffney, SC

<u>Emergency Service</u>	<u>Telephone</u>
Fire	489-6871
Police	489-8115
Upstate Carolina Medical Center	487-4271

NOTE: For ambulance, fire or police contacts, give the name of the road and the nearest intersection. In the event no telephone can be reached, Channel 9 can be accessed with a Citizens' Band (CB) Radio for emergency assistance.

Notify the following persons after emergency contacts have been made:

<u>Project Contact</u>	<u>Telephone</u>
Edward J. Zillioux	803/234-3061 (office)
SEC Health & Safety Director	803/232-3891 (home)
Peter J. Loper MD (SEC Medical Director)	803/271-9145
Bill Baskin SEC PPE Manager and Emergency Equipment Procurement	803/234-3015 (Temporary)

Spill Control Contingency Plan

Solid materials that are spilled will be scooped up, placed in appropriate containers and held for disposal. Spilled liquids will be neutralized or containerized and held for disposal. Prior to spill clean up, the SEC Health and Safety Director will be consulted to confirm that employees are protected during that work.

14.0 TRAINING OF PERSONNEL

In order to be in compliance with OSHA regulations, all personnel whose duties include participation in job-related activities on these sites, must be able to document "a minimum of 40 hours of initial instruction off the site, and a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor."

Site-specific training shall be carried out by the HSD or his designee before any SEC employee enters the site. This shall consist of a review of the specific chemicals of concern, risks, symptoms of exposure and an overview to include delineation of work zones, access, decontamination protocols, safety procedures and emergency contacts.

Any personnel not initially cleared for site entry will be provided a similar briefing at the site by the HSO before admittance into the Exclusion Zone is permitted.

The OSHA regulations provide that if previous training can be demonstrated equivalent to the OSHA initial training requirements, this shall be considered as meeting those requirements. Equivalent training includes the training that employees might have already received from actual, on-site work experience.

15.0 MEDICAL SURVEILLANCE

Sirrine Environmental Consultants, Inc., is providing medical surveillance support for numerous ongoing operations. The Medical Surveillance Program is the core element of the SEC Health and Safety Plan that provides for maximum assurance for employee as well as liability protection. The intent of this program is to detect deleterious consequences of occupational exposure to hazardous substances and physical stresses, particularly those associated with the work environment at hazardous waste sites. The Surveillance Program is designed to monitor specific physiological conditions and

mechanisms that may be affected by non-episodic exposure as well as to provide acute or episodic medical care as needed.

At a hazardous waste site, the most obvious threat to workers may be the potential exposure to hazardous chemicals. A rational, well managed PPE Program will minimize these exposures to the extent that exposure remains within safe limits. Medical surveillance is necessary, however, for several reasons. First, no matter how diligent are the training, supervision and maintenance efforts, incorrect use and the malfunction of PPE remain possible. In addition, no one piece of protective equipment is capable of providing protection against all threats, and no PPE is capable of providing absolute protection against even one threat, or for prolonged periods of time at a given level of threat. Finally, there are the less obvious threats inherent in the use of PPE. These include the inhibition and added physiological burden of wearing suits, gloves, boots, respirators, etc., while performing other tasks that of themselves may be strenuous. Also, vapor barrier protective clothing can prevent evaporation of sweat thus causing metabolic heat to be stored in the body and creating the threat of heat injury.

The SEC Medical Surveillance Program has been developed using OSHA, NIOSH, EPA, CDC, USCG, university, and industrial data sources to address the categories of hazards outlined above, and specifically in those manifestations that may be encountered in hazardous waste operations by SEC personnel.

All personnel working on these sites will have had a pre-employment physical examination conducted by an occupational health physician and, on the basis of this examination, will have been certified as being fit for duty on potentially hazardous sites. This examination consists of a minimum of the following items:

Assessments

Health history

Anthropomorphic measurements

Height

Weight

Pulse

Respiration

Blood pressure

Sensory screening

Vision

Hearing

General assessment

Physical

Social

Psychological

Nutritional

Immunization

Tetanus (if not immunized within past 10 yrs.)

Procedures

Hgb/Hct

Urine

WBC

Electrocardiograph (if over 50 years of age or indicated by physiological condition)

Multi-Chem profile

Diagnostic Multi-Chem Profile

A/G Ratio	GGT
-----------	-----

Albumin	Globulin
---------	----------

Alkaline Phosphatase	Glucose
----------------------	---------

ALT (SGPT)	Iron
------------	------

AST (SGOT) LDH

Bilirubin, Total	Phosphorus
------------------	------------

BUN	Potassium
-----	-----------

BUN/Creatinine Ratio	Protein, Total
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Calcium	Sodium
Chloride	Triglycerides
Cholesterol	Uric Acid
Creatinine	

Chest X-ray, pa. and lat.

Pulmonary function (spirometry) exam

In addition to the pre-employment and exposure-specific annual examinations, the SEC Medical Surveillance Program includes provisions for pre-placement, periodic and exit examinations for specific sites with identifiable hazards of high potential exposure levels. However, at these sites, the hazard assessment and risk analysis presented in Sections 4 and 5 of this SHERP do not indicate health risks sufficient to warrant this additional monitoring beyond the standard medical surveillance program.

Unscheduled medical examinations will be conducted, however, in the unlikely event of unusual exposures or accidents.

All medical records are maintained with the SEC Medical Director and are accessible, within the limits of the Privacy Act, through written requests to the SEC Health and Safety Director.

16.0 RECORDKEEPING

General

SEC shall maintain logs and reports sufficient to document the implementation and execution of the personnel protection program. This documentation shall consist of medical surveillance files, training files, daily logs and accident reports.

Medical Surveillance

Confidential medical surveillance files are maintained by the SEC Health and Safety Director (HSD). These files document employee participation in the medical surveillance program and fitness to work on hazardous sites. The SEC Medical Director maintains medical records. Access to these files and records is controlled by the HSD.

Training

Documentation of employee training is maintained in SEC Health and Safety files under the direction of the HSD. These files document employee attendance, level of training and follow-up or refresher instruction.

Work Logs

Daily work logs shall be maintained by the HSO. Copies of daily logs shall be forwarded to the Contracting Officer on request. The daily log shall contain:

- o Date,
- o Area(s) or site(s) worked,
- o List of employees by area and hours exposed,
- o Personal protective equipment utilized by employees,
- o Results of monitoring tests,
- o Waste materials removed from work area(s),
- o List of equipment decontaminated,

- o Description of special or unusual events or incidents, including all first aid treatments not otherwise reportable.

Daily work logs shall be checked and approved by the HSO. Any incident resulting in a work stoppage shall be fully documented in a report prepared by the HSO and submitted to the HSD.

Accident Reporting

In addition to descriptions in the daily log and work stoppage reports, any accident and/or chemical exposure incident shall be investigated, analyzed and documented in an accident investigation report submitted to the HSD. This process shall be applicable to both SEC and all subcontractors. These reports, prepared by the HSO in consultation with the HSD, shall contain a full description and analysis of the incident, including exposure work-hours and a log of occupational injuries and illnesses (OSHA Form 200 or equivalent as prescribed by 29 CFR 1904).

Formal accident reports shall be prepared for any diagnosed illness or injuries that result in a lost work day or fatality. The accident report shall identify all contributing causes and recommend future hazard control measures to reduce the risk of recurrence.

Persons on site are responsible for reporting all injuries as soon as possible to the HSO or the HSD.

17.0 JOB EXPOSURE REPORT

The HSO shall complete the attached Job Exposure Report Form (Figure 3) and deliver it to the SEC Health and Safety Director at the termination of field activities on this site, in the event of assignment of a new HSO at an intermediate point during site activities, or at the ends of discrete phases of prolonged field

activities. The intent of Job Exposure Reports is to provide documentation of actual and suspected job-related exposures for use by the SEC Medical Director in making decisions on appropriate periodic examination procedures.

JOB EXPOSURE REPORT

Project Name _____ Project Number _____

Site Location _____

Employees on-site:

<u>Name</u>	<u>Site Function</u>	<u>Dates of Site Participation</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Were all PPE, monitoring and decontamination procedures carried out in accordance with the provisions of the Site Health and Safety Plan?

Yes _____ No _____

If no, please state how procedures varied from provisions of the Health and Safety Plan, the justification or authority if appropriate, the dates of variance, and if the variance resulted in any known or suspected chemical or radiological exposure. If additional space is needed, please continue on the back of this form.

Please describe any known or suspected exposure that may have occurred during the period of site activities from accidents, unanticipated incidents or failures of personal protective equipment.

HSO Signature

Witness

Date _____
